University of Alberta

The Potential of Supply Chain Management in the Canadian Feed Barley Industry

by

Wai Mei Mimi Lee ©

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfilment of the requirements for the degree of Master of Science

in

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled **The Potential of Supply Chain Management in the Canadian Feed Barley Industry** submitted by Wai Mei Mimi Lee in partial fulfilment of the requirements for the degree of Master of Science in Agricultural Economics.

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Abstract

The study of the potential for Supply Chain Management (SCM) in the Canadian feed barley industry can provide information for producers and policy-makers to analyze the competitiveness of participants in the barley supply chain. This study discusses economic theories related to SCM, identifies SCM drivers and reviews the Canadian barley marketing system. A survey was conducted on one segment of the barley market, the feed mills in Alberta, to analyze whether there are SCM motivations in the barley supply chain. This study used the scaling method, factor analysis and stated preference technique to analyze feed mill buyers' preferences for specific product attributes and business relationships. The results indicate that SCM is not yet a part of the awareness of barley buyers at feed mills.

To my father

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CHAPTER ONE: Introduction

1.1 Background

In recent years, research has been directed into studies of vertical coordination (VC) and supply chain management (SCM). These studies focus on the causes of VC/SCM and identify the objectives of VC/SCM as well as the factors and conditions that give rise to VC/SCM. The study of SCM, also known as value-chain management, includes chain strategies that may strengthen the value and competitiveness of the supply chain, or may create barriers for new entrants.

In general, SCM is defined as a management science that identifies supply chains as entities in their own right that need to be managed as a whole to achieve better customer value with improved revenues at lower over all costs while satisfying a variety of (legal) constraints (Beers et al. 1998). In neoclassical economic terms, the objective of SCM is still maximizing the consumer's utility as well as the producer's profit. The essential question is why the economic goals are better achieved by managing supply chains instead of using open markets. Coase (1937) provided an economic framework that explains how firms choose between vertical integration and open markets to arrange production activities. The key criterion is to compare the costs of organizing an extra transaction within the firm to the costs of carrying out the same transaction on the open market. Subsequently, economists used this framework to develop transaction costs economics and predict market structure with respect to asset and product specificity. One of the basic propositions is that transaction costs are minimized when highly *standardized* and recurrent transactions are taking place on the open market or when highly *specific* and recurrent transactions are to be arranged by a vertical coordinated system.

For the last decade, attention has been drawn to study contracting relationships in the agri-food industry using a transaction costs approach. Hobbs and Young (1999) study the relationship between product and transaction characteristics to explain the observed increase in VC. Other researchers (Kennett 1997; Martin and Zering 1997; Martinez et al. 1997; Hennessy 1996) consider that information asymmetry can be commonly identified as a type of transaction cost in open market transactions and suggest that VC increases as information on product quality becomes important. These studies highlight the changes in production technology and consumer preferences that offer opportunities to add value to agricultural products. Hobbs and Young (1999) suggest that there is a trend for agricultural products to be more differentiated and the prices to be more directly tied to the product quality. As the product demand becomes more specific and the important product attributes are quality attributes that cannot be readily identified at the time of the exchange, the businesses along the vertical supply chain may co-ordinate their activities to eliminate uncertainties about the product quality required.

In general, SCM is examined as a way to organize agricultural systems to operate more efficiently and profitably in specific markets. Wilson et al. (1998) studied the importance of logistics in the grain industry to reduce costs through SCM. Martinez et al. (1997) studied the increasing VC in the US pork industry and suggested that VC helped to ensure the processing plants operate at optimum capacity. Consumers benefited from lower pork production costs and a large supply of high-quality pork products. Hobbs and Young (1999) studied various Canadian and US grain industries and suggested that production contracts were used to improve product quality and ensure food safety. Hobbs and Young (1999) observe that the use of contracting or VC has become increasingly important in Canadian and the US agricultural industries. The trend towards closer VC is notable in the US pork and poultry industries. Although the use of contracting in Canadian agriculture has not been as extensive as in the US, studies by Hobbs and Young (1999), Schmitz and Schmitz (1994) and Hollander (1990) predict that Canadian agriculture will move towards the US structure.

Canada is a major producer of feed grains, livestock and livestock products. Applying SCM to enhance the welfare of these industries in Canada may increase these industries' competitiveness in markets nearby and overseas. Traditionally, barley is used for animal feed. It is an economical source of energy and protein. Barley is a dominant ingredient in the Canadian beef and dairy cattle and hog rations. Livestock feed accounts for more than 60% (8 million tonnes) of total barley production usage (Agriculture and Agri-Food Canada 1996). Western Canada, on average, accounts for 90% of Canadian barley production and 84% of Canadian beef cattle (Statistics Canada 1997a). Alberta maintains the largest beef cattle herd and the largest acreage in the Canadian barley production. Alberta's beef cattle industry is the province's largest single source of farm revenue accounting for 44% (2.8 billion) of total farm cash receipts in 1998, which is half of Canada's cattle revenue (AAFRD 1999). After the beef industry, the hog sector in Western Canada accounts for about 22% of total domestic barley consumption (Agriculture and Agri-Food Canada 1996). On the whole, barley accounts for 43% of the total feed grains consumed by the Canadian livestock and poultry industries (Agriculture and Agri-Food Canada 1997).

For decades, researchers have tried to develop less time-consuming and more sophisticated techniques to evaluate feeds. Recently developed technology allows detailed analysis on the feed quality characteristics of barley and provides useful information for sophisticated feed formulation. Recent research is evaluating barley grain quality that is more specific with respect to each type of animal. For instance, Khorasani et al. (1998) compared 60 barley cultivars and discussed the concept of designing feed barley with ideal nutritional qualities for dairy cattle. Zijlstra et al. (1998) evaluated the swine digestible energy of 40 barley samples and measured the variance of economic value of each barley sample based on a typical diet for grower pigs. They found that the value of the barley samples varied from $78 to $139 per 1000 kg.

The advancement in technology and research may change the perspective that all types of barley are homogenous. Moreover, research on targeted barley varieties, which can give the feed an economic advantage to the producer, feed processor and livestock producer, has been proposed as a strategy needed to sustain the competitive position of barley as a feed (Racz 1998).

In addition to the advancement in technology and research, changes in consumer preferences and regulatory requirements are also considered drivers for applying SCM in the agri-food industry (Hobbs and Young 1999; Boehlje et al. 1998; Wilson and Clarke 1998). Consumer preferences for grains with enhanced health characteristics and livestock feeder preferences for grains with enhanced feeding value may need some form of VC to produce specific grains or grain products (Hobbs and Young 1999). Government regulations for traceability in agricultural supply chain have been enforced in some countries to help increase consumer confidence in food safety. For instance, the 1990 Food Safety Act in UK has increased the legal liability of food firms causing them to seek more information about upstream production practices in the food supply chain (Hobbs and Young 1999). The Food Standards Agency report in 1997 advocates the creation of an independent body to oversee the entire food production process in the UK (Wilson and Clarke 1998). Also, in 1998, the EU endorsed plans to extend product liability laws to farmers (Hobbs and Young 1999). These changes in regulatory environment are driving some markets to establish information-sharing systems in agricultural supply chains (Hobbs and Young 1999; Wilson and Clarke 1998).

A cattle identification program to enhance trace-back capabilities in the Canadian beef industry is to be implemented by January 2001. All cattle are to be tagged with an approved Canadian Cattle Identification Agency ear tag when leaving their herd of origin (Canadian Cattlemen's Association 2000). Livestock producers in the future may be required to provide details on all key inputs into the livestock. This may include the management practices used to produce the barley.

1.2 Study Objectives

The feed barley market and the livestock industry are changing. Emerging issues include targeting specific feed barley varieties to specific livestock application and food trace-back. SCM is proposed as one model for meeting these market challenges.

However, the theories associated with SCM are not well defined. Therefore the objectives of this study are:

1. to review economic theories that are applicable to SCM;
2. to examine barley marketing in Canada;
3. to identify SCM drivers for the Canadian feed barley market; and
4. to study one specific segment of the feed barley market, the feed mills, and analyze the potential for SCM in the feed mill market.

A survey of buyers' preferences in Alberta's feed mill industry was conducted. Respondents were asked to evaluate the importance of some selected product and seller attributes on barley purchasing decisions. The results are analyzed using the scaling method, factor analysis and stated preference technique. The hypotheses to be tested are:

I. Non-visual or non-identifiable traits are important to barley purchasers;
II. A known supplier is important to barley purchasers;
III. The ability to trace back the barley varieties, field grown and all agronomic practices is potentially important to barley purchasers.

Non-rejection of the above hypotheses will indicate that market factors are moving the Canadian barley industry in the direction of SCM.

1.3 Study Plan

Chapter 2 reviews SCM economic theories and research studies with applications to SCM. The economic theories include transaction costs economic theory, industrial organizational theory, strategic management theory and game theory. This is followed by a summary of the motivations for SCM. Chapter 3 reviews the history of barley marketing in Canada and briefly examines the roles of institutions in the barley industry. It also summarizes relevant statistics in barley production, varieties, exports and the feed barley demand by livestock industry and provides an overview of recent developments in defining the quality of feed grains. Chapter 4 gives an account of the theoretical framework for statistical analysis of the feed mill survey. Chapter 5 introduces the survey design and the research methodology of this study. Chapter 6 summarizes the results and findings from the survey. Chapter 7 provides conclusion and suggestions for areas of further research.

CHAPTER TWO: The Economic Theories Applied to Supply Chain Management

2.1 Introduction

The literature on SCM is advancing toward the development of a comprehensive theory (Zylbersztajn and Farina 1998). Different disciplines emphasize different areas of SCM. Management science focuses on the logistic problem of how to strategically manage the acquisition, movement and storage of material, parts and finished inventory (Christopher 1992). Engineering looks at the implications on the product design that include a supply chain perspective on reducing manufacturing costs, logistic costs and give flexibility in dealing with unexpected changes (Lee 1993). Sociology studies factors such as trust, commitment, power and reciprocity that influence the outcome of relationships along the supply chain (Graaf and Uitermark 1998). Meanwhile, economics focuses on transforming traditional economic theories into applied tools for designing efficient marketing system (Zylbersztajn and Farina 1998). This chapter:

1. reviews the economic theories that are applicable to SCM/VC;
2. gives an overview of the research focus in recent economic studies on SCM;
3. distinguishes SCM from VC;
4. summarizes previous economic tools used to study SCM; and
5 concludes on the applicability of SCM to the Canadian feed barley industry.

2.2 Economic Theory Review

This section reviews the economic theories that are applicable to SCM/VC. These include transaction cost economics theory, industrial organizational theory, strategic management theory and game theory. Each theory uses a unique approach to express its dominant perspective and make predictions. An overview of these economic theories is given as follows.

2.2.1 Transaction Cost Economics

When tracing SCM's roots in the transaction cost economics (TCE), discussion often begins with Robert Coase's ground breaking paper (1937), "the Nature of the firm". TCE describes economic activities as a series of exchange transactions coordinated either by price movement in the open market, or by the entrepreneur within a firm. The entrepreneur faces the decision of adding more transactions into the firm or acquiring them from the open market. The key criterion is to compare the costs of organizing an extra transaction within the firm to the costs of carrying out the same transaction on the open market. The open market assumes that both consumers and producers are numerous and the sales or purchases of each individual unit are small in relation to the aggregate volume of transactions such that the price cannot be varied by an individual's action in the market.

Coase's theory of the firm provides the economic framework with two extremes, the open market on one end and vertical integration on the other. It recognizes the firm's capacity to coordinate production activities, and introduces the "efficiency" concept of whether all production stages should be processed by one firm or two or more. Unlike standard neoclassical economists, Coase (1937) recognizes that there are costs to use the market mechanism such as the cost of price discovery.

Williamson (1986), a major contributor to TCE theory, uses Coase's framework to predict market structure based on both asset and product specificity. TCE uses a contractual approach to the study of economic organization, and any issue that can be formulated as a contracting problem using TCE terms. Williamson (1986) introduces the economic importance of asset specificity and the TCE in relation to the governing structure of the business firms. Williamson (1986) suggests that asset specificity is one of the critical factors that can predict whether the contractual relationship is sustainable in the long run. He concludes that parties who are engaged in a trade that is supported by non-trivial investments in transaction-specific assets are more likely to be operating effectively in a contracting relationship.

The asset is specific when one or both parties to the transaction make investments that involve characteristics specific to the transaction and which have lower values in alternative uses. For instance, an individual decides to build a feed mill near a large feedlot in order to sell feed to the feedlot at prices that would generate quasi-rents or profits above a normal rate of return. However, once the investment in the feed mill is made, the feedlot may try to renegotiate a lower price in order to take most of the quasi-rents. The feed mill operator may be forced to accept a price that is only slightly above what the feed mill assets would earn at their next best alternative (which could be selling feed to the next nearest feedlot). Moreover, TCE assumes that human agents are subject to bounded rationality. The behavior is rational but limited to opportunism, a condition of self-interest-seeking. If the parties are opportunistic and assets are specific, the owners of assets specific to a transaction must bear the risk of future exploitation by other participants or engage in costly bargaining to reduce that risk or consider integrating with the other parties into one firm.

Williamson (1979) classifies the governance structures into three broad types, the non-transaction-specific, semi-specific and highly specific. The open market is the classic non-specific governance structure, which is tailored to instantly exchange standardized goods at equilibrium prices. By contrast, the highly specific structures are tailored to the special needs of the transaction. Williamson (1979) gives three propositions about these governance structures in relation to the transaction characteristics and they are:

1. Highly standardized transactions are not apt to require specialized governance structure
2. Only recurrent transactions will support a highly specialized governance structure
3. Although occasional transactions of a non-standardized kind will not support a transaction-specific governance structure, they require special attention.

These propositions create the study of comparative marketing systems, which are chosen depending upon the transaction costs attended to each. The transaction costs are minimized when highly standardized and recurrent transactions are taking place in the open market, or the highly specific and recurrent transactions are arranged by a vertical coordinated system.

Williamson's discussion about vertical integration with strong emphasis on asset/transaction specificity and opportunistic behavior has been challenged. Foss and Knudsen (1996) suggest that vertical integration should also be studied as an innovative strategy. The discussion on strategic control through contracting in agri-food sector can be traced back to the study by Ronald Mighell and Lawrence Jones in 1963. Mighell and Jones (1963) discussed contract production as a form of vertical integration on the ground that a firm is able to exert some control over other firms through a contract. They classify contracts into three categories: the market-specification, the production-management and the resource-providing contracts. Each of them indicates the degree of participation of the contractor. In **market-specification contracts**, the producer transfers part of the risk and management function to the contractor so that he/she can be more certain of the market and the price. An example of this class is a dairy farm that produces milk under contract to a fluid milk distributor. In **production-management contracts** the contractor has more direct participation in production management. The management usually takes the form of resource specifications and field inspections during the production period. It becomes important when the quality of the product is important to the buyers. An example of this class is a sugar company, which may specify seed variety, fertilizer analysis, water use, land rotation practices, and harvest and delivery dates. In **resource-providing contracts**, the contractor not only furnishes a market and participates in production management; he/she also provides important inputs. For instance, broiler producers may relinquish to the contractor the function of providing most of the operating resources, such as chicks, feed, and medicine.

Mighell and Jones (1963) observed that if contractors could profitably buy from or sell to agriculture markets without investing resources in farm production, they would refrain from such an investment. Only in a few instances was it found advantageous for the contractor to finance farm production entirely within their firms. Mighell and Jones (1963) perceive that the main advantage in contracting farm products is to change the market structure to a higher degree of concentration, which will result in relatively high barriers to entry. The discussion of market power will be examined more extensively under industrial organization theory.

2.2.2 Industrial Organizational Theory

The theory of industrial organization is about analyzing the functioning of markets. The first wave of interest is associated with the names of Joe Bain and Edward Mason, the so-called "Harvard tradition" that developed the "structure-conduct-performance" paradigm (Tirole 1988). The argument is that the market structure determines the industry's conduct and the conduct yields certain market performances. In general, the **market structure** is measured by the number of sellers in the market, the degree of product differentiation, the cost structure and the degree of vertical integration with suppliers. The **conduct** consists of price, investment, advertising as well as research and development. The **market performance** is measured in term of profits, ratio of price to marginal cost, product variety, efficiency, innovation rate and distribution (Tirole 1988).

The basic paradigm hypothesizes that certain market structures are conducive to monopolistic conduct, the raising of price above marginal costs. It assumes that the profit and price data are observable. For instance, the principal method to measure the concentration in a particular market is the Lerner index (M) defined as (Tirole 1988):

$$M = (\text{Price} - \text{Marginal Cost}) / \text{Price}$$

Under pure competition, M=0. The higher the Lerner Index value, the more the firm's pricing departs from the competitive norm. The neoclassical economic theory suggests that the degree of competition is related positively to the number of firms in the relevant industry. Thus, industrial-organization economists try to summarize the distribution of market shares among firms in a single index, the concentration index defined as $\alpha_i = q_i/Q$ denoting i's market share (Tirole 1988). A common method of measuring concentration is the four-firm sales concentration ratio CR_4, a ratio of the four largest companies. If the CR_4 is higher than 75%, it reflects an oligopoly that is very concentrated, while a CR_4 of below 25% indicates the existence of a more active competition (Scherer and Ross 1990).

The "structure-conduct-performance" paradigm is criticized for being based on loose theories and its emphasis on empirical studies of industries. The typical empirical regression is in the form of measuring profit as a function of concentration ratio, the difficulty of entering the industry and the ratio of advertising to sales. The regression may produce a useful array of stylized facts but it lacks the theory to explain causal relationships, such as what causes a high degree of concentration or market power (Tirole 1988).

Nevertheless, several SCM/VC studies (Martinez et al. 1997; Joskow 1995; 1987; Mighell and Jones 1963) have highlighted that increasing market power is one of the economic forces for SCM/VC. Firms tend to maximize profits by vertical integration or coordination to gain market power, create entry barriers, exercise price discrimination or at the very least remain competitive with other market groups.

2.2.3 Strategic Management Theory

The strategic management theory with implications to SCM is reflected both in the resource-base view and institutional theory approaches. The resource-base view provides an explanation for the observed increase in firm ***heterogeneity*** through vertical co-ordination with resource suppliers. Institutional theory provides an explanation for the observed increase in firm *homogeneity* because conformity to social expectations contributes to organizational success and survival. These theories offer a framework that on the one end, the resource-base view theorists predict increasing vertical co-ordination due to product differentiation and on the other, the institutional theorists predict no incentive for vertical co-ordination because of standardized products and quality.

i) Resource Base View

The resource-based view proposes that resource selection and accumulation are the function of both within-firm decision-making and external strategic factors. Within-firm managerial choices are guided by economic rationality and by motives of efficiency, effectiveness and profitability (Conner, 1991). External influences are strategic industry factors that impact the firm, including buyer and supplier power, intensity of competition, and industry and product market structure. These factors influence what resources are selected, as well as how they are selected and deployed.

The resource selection and deployment is seen as a way of setting up barriers of acquisition, imitation and substitution. These barriers inhibit competitors' abilities to obtain or duplicate critical resources and lead to long-run differences among firms in their abilities to generate rents. The market strategy is found in terms of limiting the resource mobility or unequal distribution of resources across the competing firms. The resource base view assumes that economic motives drive resource procurement decisions, and economic factors in the firm's competitive and resource environments drive the firm's conduct and outcomes. Using a resource-base approach, Amit and Schoemaker (1993) defined strategic assets by valued resources and capabilities, where resource selection and control are used by firms to develop and implement their strategies, which requires capabilities to coordinate and deploy resources to obtain competitive advantages. The differences among firms in the resources they select may generate firm heterogeneity in the long run (Barney 1991).

The study of strategic management using a resource-base approach is applicable to SCM studies as one of the driving forces for competing firms is to integrate or co-ordinate through contracting with their input suppliers. Moreover, the ability to control valued resources may include the ability to control non-physical inputs such as update information about changes in consumer preferences or genetic information related to the quality of crops.

ii) Institutional Theory

The institutional view suggests that the motives of human behavior extend beyond economic optimization to social justification and social obligation (Zukin and DiMaggio 1990). According to institutional theorists (Baum and Oliver 1991; Carroll and Hannan 1989; DiMaggio and Powell 1983), conformity to social expectations contributes to organizational success and survival. Unlike economic and strategic frameworks, which examine the extent to which firm behavior is rational and economically justified, institutional theorists emphasize the extent to which firm behavior is compliant, habitual, unreflective, and socially defined. Institutional theory suggests that institutionalized activities are the result of interrelated processes at the individual, organizational, and inter-organizational levels of analysis. At the individual level, managers' norms, habits and unconscious conformity to traditions account for institutionalized activities (Berger and Luckmann 1967). At the firm level, corporate culture, shared belief systems, and political processes give ways of managing that perpetuate institutionalized structures and behaviors. At the inter-organizational level, pressures emerging from government, industry alliances and societal expectations like rules, norms, and standards about product quality, occupational safety and environmental management, define socially acceptable firm conduct. The social pressures common to all firms in the same sector cause firms to exhibit similar structures and activities (DiMaggio and Powell 1983).

The institutional theorists hypothesize that firms have a tendency to conform to predominant norms, traditions, and social influences in their internal and external environments. This leads to homogeneity among firms in their structures and activities. Successful firms are those that gain support and legitimacy by conforming to social pressures.

The study of the conformity behavior within an industry is important to SCM studies. The firms, which share this behavior, are trading highly standardized products of similar quality and have less incentive to co-ordinate or integrate than those that are trading specific products with large variances in quality.

2.2.4 Game Theory

Game theory is the study of multi-person (agent) decision problems. Basically, there are four kinds of games: the static game of complete information, dynamic game of complete information, static game of incomplete information and dynamic game of incomplete information. To formalize a game, one has to describe the form of the game (i.e. the order of play), the set of information and payoffs, the probability distribution for moves by "nature" if possible. Given the information, one can work out a set of strategies and look for the Nash equilibrium (an equilibrium that the players will not choose to deviate from). There can be more than one equilibrium especially in games that consist of multiple stages.

To make an optimal decision, a player must generally foresee how the player's opponents will behave. Initially, the player can eliminate any strictly dominated strategies by the assumption that the opponents are "rational". That is to say, they will not pick actions that always give lower payoffs than another action. The process stops when no more dominated strategies can be found. A unique solution may be found by this method, for instance, the famous "Prisoners' Dilemma" game. Nevertheless, the Nash theorem (1950) guarantees that in the n-player normal-form game, (where all the players' strategy spaces and their payoff functions are specified), if the number of players is finite and the set of strategies for every player is also finite, then there exists at least one Nash equilibrium, possibly involving a mixed strategy (a probability distribution over the pure strategies).

Game theory in general, analyzes the behavior of competing firms, which share all the characteristics of a contest or game. There are many findings and implications on inter-firm cooperation, especially for oligopolies. However, there is not any particular study on inter-firm cooperation along the supply chain or prediction for SCM/VC. Nevertheless, it is worthwhile to mention that the "trigger strategy" in repeated games may offer some intuitions to the obstacle of inter-firm cooperation such as "opportunism". The infinitely repeated games show that the credible threats or promises about future behavior can influence current behavior. Consider the single stage "Prisoners' Dilemma" game as follows,

		Player 2	
		L_2	R_2
Player 1	L_1	1,1	5,0
	R_1	0,5	4,4

The above payoff table shows that if player 1 chooses to play strategy "L", he/she would receive payoff of 1 if player 2 chooses to play strategy "L" or receive payoff of 5 if player 2 chooses to play strategy "R". On the other hand, if player 1 chooses to play strategy "R" instead of "L", he/she would receive a lesser payoff. That is, player 1 would receive the payoff of 0 if player 2 chooses to play strategy "L" or receive payoff of 4 if player 2 chooses to play strategy "R". Therefore, one can predict that player 1 will always choose to play strategy "L" because whether player 2 plays "L" or plays "R", player 1 will get higher payoff by playing strategy "L". Moreover, the same type of payoff is given to player 2 simultaneously. Therefore, the best response for each player is to play "L" because according to the payoffs, the strategy "R" is strictly dominated by the strategy "L". If player i is going to play "L_i", the other would prefer to play "L_j" and get a payoff of 1 rather than play "R_j" and get nothing. Similarly, if player i is going to play "R_i", the other would prefer to play "L_j" and get a payoff of 5 rather than play "R_j" and get a payoff of 4. However, the predicted outcome is not pareto-efficient as both players can get a higher payoff if they both play "R".

Nevertheless, when the "Prisoners Dilemma" game is expanded to an infinitely repeated game, it becomes possible to observe a pareto-efficient outcome, given that the outcome of the t-1 preceding plays of stage game are observed before the tth stage begins. The payoffs of the infinitely repeated game are the sum of the payoffs from the infinite sequence of each stage discounted by $\delta = 1/(1+r)$, where r is the value today of a dollar to be received one stage later. Although the only Nash equilibrium in the single stage "Prisoners Dilemma" game is non-cooperation, there is a second Nash equilibrium in the two-stage repeated game and that is if the players cooperate today then they play a high-payoff equilibrium tomorrow; otherwise they play a low-payoff equilibrium tomorrow. This strategy can be extended in the infinitely repeated game as cooperating until someone fails to cooperate and is the so-called "trigger strategy". Provided δ is close enough to one, if player i has adopted the trigger strategy, it is also a best response for player j to adopt the strategy as well (Fudenberg and Maskin 1986). It is important to note that the smaller the values of δ, the less effective is the punishment next period, in deterring a deviation this period. The trigger strategy approach in the Prisoner Dilemma game is the strongest credible punishment but in most games, it is not. Abreu (1986) suggests that the most effective way to deter a player from deviating from a proposed strategy is to threaten to administer the strongest credible punishment by playing the subgame-perfect Nash equilibrium[1] of the infinitely repeated game that yields the lowest payoff of all such equilibria for the player who deviated.

As far as SCM/VC is concerned, the "trigger strategy" in game theory may offer some implications on preventing "opportunism", which is a critical constraint identified by TCE as one of the factors blocking two parties from entering into a contract or cooperation to gain quasi-rents/profits. Although the literature of game theory with application to SCM/VC is still limited, game theory provides a basic framework to analyze inter-firm cooperation by different payoff specifications. Game theory also provides the rationale for co-operation, which indicates that profits or benefits can result through SCM where each business retains a separate identity.

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[1] A Nash equilibrium is subgame-perfect if the players' strategies constitute a Nash equilibrium in every subgame (Selten 1965)

2.2.5 Summary and Conclusion

The traditional economic theories reviewed in this section provide explanations or predictions from various perspectives and assumptions about what causes the market structure to move towards vertical integration/coordination. In summary, the TCE analyzes the asset specificity of the firm and its linkages to the market structure of the industry. It also analyzes the product specificity that determines whether the transactions will take place more efficiently through vertical integration/coordination than in open markets. The industrial organizational theory makes assumptions and theories on the structure, conduct and performance of firms and analyzes them within an industry or across industries. The theory develops measurement like the Lerner index and concentration index for finding a set of stylized facts that may have implications on vertical integration/coordination in an industry. The strategic management theory analyzes the market from strategic viewpoints. The theory offers two possible outcomes: increasing vertical co-ordination to produce heterogeneous products predicted by the resource-base view theorists and no incentive for vertical co-ordination because of standardized products and quality predicted by institutional theorists. Both predictions give special implications on the impact of product specificity with respect to the market structure of an industry. Finally, the game theory analyzes the interactions of firms by evaluating the payoffs on cooperative strategies.

Based on the reviewed economic theories, applied economists when investigating the potential of applying SCM, should consider:

1. the asset specificity of the firms and the product specificity in demand;
2. the structure, conduct and performance of the industry;
3. the firms' norms and strategies;
4. the payoffs (costs and benefits) of firms under SCM; and
5. the exogenous factors like government policies and regulations as well as the impacts of social norms and society goals.

2.3 SCM Studies

This section reviews selected economic studies on SCM, namely, "SCM: the Case of a UK Baker" and "the Case of Pendleton Flour Mills Inc" by Julie Kennett (1997; 1998a; 1998b), "Information Asymmetry as a Reason for Food Industry Vertical Integration" by David Hennessy (1996), "Increasing Vertical Linkages in Agrifood Supply Chains: A Conceptual Model and Some Preliminary Evidence" by Hobbs and Young (1999) and "Observations on Formation of Food Supply Chains" by Boehlje et al. (1998). Several of these studies have set their economic foundation on transaction cost economics and consider vertical coordination as a way to reduce the transaction costs of exchanging product in the open market. Both Kennett (1997; 1998a;1998b) and Hennessy (1996) focus on the issue of quality uncertainty whereas Hobbs and Young (1999) and Boehlje et al.(1998) focus on the motivations and drivers for SCM. These studies are summarized and their implications that are applicable for the study of SCM on the Canadian feed barley market are analyzed.

2.3.1 Kennett (1997, 1998a, 1998b)

Kennett studies the US wheat grading system and argues that the variation in grain quality provides an incentive to manage the wheat supply chain. She suggests that in the case of an open market system with no grading, high quality wheat receives the price of the low quality wheat due to the lack of information about quality. In the case of an open market system with a grading system that is assumed to be capable of segregating all grains by quality, Kennett suggests that if an individual processor pursues specific quality attributes and is able to market the product at premium, he/she will segregate the quality through contractual arrangements with producers whose grains possess the most desirable end-use characteristics.

Kennett's model predicts that in the wheat market there are rent seeking motivations for SCM. An example she gives is the case of Warbutons Ltd, an UK bakery who pursues the unique quality specifications to differentiate its product by targeting consumers who look for consistently good quality bread. Warbutons conducted research to find the best formula for its unique baking needs and then sourced these specific wheat requirements from Canada. Subsequently, it contracted with wheat producers from Western Manitoba through Manitoba Pool Elevators and under the guidance of the Canadian Wheat Board. Kennett concludes that the variation in grain quality provides an incentive to manage the supply chain.

Kennett also studies the case of Pendleton Flour Mills Inc. The company is a supplier of premium quality flour products to niche markets. It operates a stringent testing program to segregate US wheat supplies with specific intrinsic quality attributes. One of the reasons for taking this strategy is that the current US grading system bears little correlation to the wheat's actual functionality. For instance, the information about test weight and foreign material gives little indication as to its baking performance. Despite the effort Pendleton has made, it has no control over some factors that determines the quality of flour because it is not directly involved in sorting wheat classes from producers. Pendleton believes that at present, its best strategy is the "test and reject" policy in terms of cost-effectiveness. Pendleton does not achieve quality assurance through contractual arrangement because it believes that the costs associated with identity preserving contracts, such as additional premiums to producers and management fees to grain companies, cannot be justified.

Kennett's case studies reveal that the motivation to pursue high quality wheat may or may not necessarily result in SCM/VC. If the laboratory testing for wheat quality is accurate and inexpensive, the incentive to apply SCM may substantially decrease especially when the costs of segregating high quality wheat and managing contracts are significant. Also, variability caused by the environment may reduce the effectiveness of supply chains.

In view of Kennett's case studies in the wheat market, this study of SCM for the Canadian feed barley industry should begin by examining whether there are buyer motivations to pursue barley of high feeding value for feed. As well, the technology of laboratory tests for barley quality should be examined and the implication for SCM should be analyzed. Quick, accurate and inexpensive laboratory tests may lower the incentive for SCM. It may be optimal for companies to rely on laboratory test and reject the crop that is below standard due to high environmental variability, where the quality of the crop is highly related to conditions of nature such as weather, pest etc. In the Warbuton's case, it is presumed that there is adequate SCM control to reduce environmental variability whereas in the Pendleton's case, there is too much variability in the environment. Pendleton's best strategy is to select after the crop is grown.

2.3.2 Hennessy (1996)

Hennessy focuses his arguments on the problem of information asymmetry, where perfect information about the quality is only available for the seller, not the buyer. By using a mathematical proof, he explains why the price information given by the open market is not adequate in sending signals to accommodate changing consumer and processor demands. His model assumes that there are two types of farms. One has invested in quality-related capital and the other type has not. Both types of farms may produce high grade and low-grade products, but those who have invested in quality-related capital, will produce a lower share of low-grade products. Hennessy also assumes that food processors do not observe farm-level decisions but depend on a quality test which has the possibility of identifying a high grade product as low grade or vice versa. Since the test for quality is not completely accurate, the sampling test does not serve the purpose of sorting out the high-grade product but rather to protect the processor's reputation in the consumer marketplace.

Since the processor will pay the price that is weighted according to the test results, the expected price will only increase as the probability of high quality product increases. On the other hand, the farm will only invest as long as the investment increases profit. Thus, the crucial factor is placed on the accuracy of the test. An inaccurate testing will cause the average revenues for an invested farm and a non-invested farm to converge to the same earnings. Consequently, there will be no incentive for farms to invest. This is a case of an externality where imperfect information allows the non-invested farms to get a free ride on the quality created by the investing farms. In conclusion, Hennessy identifies quality uncertainty as transaction costs in the open market, which may be a driver for vertical integration. If a firm both produces and processes, it does not need to test to learn about average quality.

Hennessy's study suggests that the motivation for vertical integration may come from quality uncertainty especially when quality testing is inaccurate. It highlights the importance of accurate, cheap and quick quality tests for measuring hidden attributes. It also demonstrates that a marketing system that prices product by average quality will discourage investments in higher quality production. As a result the industry may become less competitive in the long run. An alternative is to integrate or coordinate the buyers and sellers to contract for high quality production. Strategic alliances between livestock and barley producers may be driven by the demand for specific or high quality barley. The presence of this motivation can be indicated by analysis measuring:

1. quality attributes that are important to barley purchasing decisions;
2. the importance of dealing with suppliers who are willing to guarantee barley quality is important to barley buyers;
3. buyers' preferences for specific barley varieties for feed.

2.3.3 Hobbs and Young (1999)

To explain the observed increase in VC, Hobbs and Young study the relationship between product and transaction characteristics using transaction costs approaches. Specific transaction characteristics such as the uncertainty of product quality, the price and reliability of supply are caused by product characteristics such as high perishability and high quality variability. For instance, a highly perishable food product will create uncertainty for buyers with respect to the product quality and the reliability of supply.

Likewise, high variability in quality will result in more product differentiation and cause uncertainty over product quality and price, where the price is assumed to be closely tied to the product quality.

Hobbs and Young suggest that some product characteristics or transaction environments are affected by technological, regulatory and socio-economic factors. The examples of these factors are: biotechnology that can introduce novel product characteristics, which result in more product differentiation; legislative control such as the 1990 Food safety Act in the UK, which increased the legal liability of food firms and caused increase in traceability of the food supply chain; and changes in consumer life-styles and preferences that increase the demand for high quality food.

Hobbs and Young review the statistics on the use of contracting in the US agricultural industries. Production under contract is more prevalent in the livestock than grains industry. Nevertheless, Hobbs and Young present the case of Optimum Quality Grains (OQG), a company that develops and markets value-enhanced grains. OQG licenses its high oil corn to independent seed companies and partners with a network of elevators. Buyers contract directly with OQG, who coordinates growers and elevators. OQG evaluates and inspects the condition of the crop as well as controls the movement of high oil corn from elevators to domestic and foreign end users. Hobbs and Young suggest that value-enhanced grains are usually produced under contracts. In view of the substantial investment in research and development of the trait-enhanced grain varieties, they predict that the value-enhanced grains as a percentage of the total grain production will increase and so will the use of contracting.

Hobbs and Young's study highlights potential SCM drivers, namely, firms' investment in technology to develop value-enhanced grains, the legislation that requires trace-back capabilities in the food supply chains and livestock feeders' preferences for grains with enhanced feeding value. When considering whether SCM is an alternative for the Canadian feed barley marketing system, this study should consider whether the technological, regulatory and socio-economic factors are driving the industry to increase the use of contracting or some forms of SCM. In Canada, a cattle identification program to enhance trace-back capabilities in the Canadian beef industry is scheduled for January 2001. All cattle are to be tagged with an approved Canadian Cattle Identification Agency ear tag when leaving their herd of origin (Canadian Cattle Identification Agency 2000). Livestock producers in the future may be required to provide details on all key inputs into the livestock. This may include the management practices used to produce the barley. Also, recent studies (Khorasani et al. 1998; Zijlstra et al. 1998) show that barley grain quality is more specific with respect to each type of animal. The research on barley grain quality may change the perspective that all types of barley are homogenous. Livestock feeders' preferences for grains with enhanced feeding value may lead to some form of VC to produce specific grains or grain products (Hobbs and Young 1999). The presence of these SCM drivers in the Canadian feed barley industry can be indicated by analyses measuring:

1. if quality characteristics of barley are important to feed barley purchasing decisions;
2. if there are feed barley buyers' preferences for a specific type of barley for feed; and
3. if trace-back capabilities of barley are or will be important in feed barley purchasing decisions.

2.3.4 Boehlje et al. (1998)

The study by Boehlje et al. discusses the motivations, conditions and opportunities for SCM in the food industry. The formation of food supply chains occurs in three phases. In phase one, the focus is on cost reduction, which may require some kinds of coordination of activities. The next phase is focusing on risk reduction that may result in vertical integrating with input suppliers or controlling inputs through contracting. The final phase emphasizes consumer responsiveness, where information becomes a valued asset that ties together the production stages to ensure quality control and that the product attributes are specifically demanded by consumers.

Boehlje et al. argue that the formation of chains follows three phases because cost reduction is relatively easier to measure and identify whereas the problem of measuring risk reduction is more complicated. In comparison, increasing the responsiveness to the consumer is the most difficult to measure and improve because consumer behavior may not be consistent. The consumer's tastes and preferences are changing and dynamic.

Boehlje et al. contend that the first point of control in the supply chain is the end-user/consumer and those firms that have intimate contact with the consumer. The second point of control is the raw material supplier. The control highly depends upon the degree of substitutability for a business input or contribution to the production process. The firm between the two ends is less likely to obtain control unless they possess superior information. The issues of control in a chain and the sources of the power can be separated from those of implementation and organization. The "controller" may simply set the standards or the rules of the game, and negotiate with someone else to enforce and monitor the performance.

Boehlje's study highlights the important motivations driving SCM and these are: cost reduction, risk reduction and consumer responsiveness. It also highlights the importance of identifying the opportunities for SCM such as an increase in importance of product attributes that require coordination to design new products, changes in farm size, changes in farm investments and changes in technology. To evaluate SCM in the Canadian feed barley industry, this study considers whether there are trends for increases in farm size, market concentration, and asset specificity. It also considers whether the advancement in feed evaluation technology and research on barley quality attributes have changed the buyer's perception that barley is a homogenous product.

2.4 Difference Between SCM and VC

The term "vertical coordination" referenced to Mighell & Jones (1963), includes "all the ways in which the vertical stages of production are controlled and directed" (p.10). As pointed out by Coase, the vertical stages of production are carried out within or between firms depending on the cost of using the open market. If the coordination takes place within a single firm, it is considered vertical integration. The difference between integration and coordination is the degree of autonomy. The former is viewed commonly but not necessarily to be more centralized.

Most marketing systems involve both integrated and non-integrated kinds of coordination. Besides minimizing transaction costs, there are other reasons for firms to coordinate. In recent years, there has been a tremendous increase in health consciousness, which brings new demands and challenges to the agriculture-food sector. In addition to the new technology developed for the identification of product attributes, product differentiation has arisen to meet consumer demand. Under these circumstances, open markets that handle homogenous products become inefficient and ineffective in conveying quality information (Kennett 1997; Martin and Zering 1997; Martinez et al. 1997; Hennessy 1996). VC may emerge to complement or replace the open market system.

Zylbersztajn and Farina (1998) suggest that SCM implicitly assumes that the marketing system is manageable and the organizations and institutions can be shaped to support an efficient system. SCM theories should identify parameters that determine the design of an efficient marketing system.

2.5 Previous Economic Tools for SCM

Many studies attempt to demonstrate what leads to SCM/VC. Not all of them are based on the same assumptions and arguments. These studies lack a coherent theory. Economic tools for studying SCM are still minimal. Most studies are case studies, documentation of SCM experience/phases and identification or estimation of transaction costs that could be eliminated by SCM. Zylbersztajn and Farina (1998) have aptly commented that although the industrial organization theory provides the necessary support to address the problems as well as to discuss and improve the understanding of agribusiness systems, there is a long journey from the definition of the object of analysis to the development of a theory, which permits hypotheses to be tested and predictions to be made about economic efficiency of alternative agribusiness marketing systems.

2.6 Conclusion on the Applicability of SCM Theories and Studies to Our Problem

Although the theory of SCM has not yet matured, the investigation of the potential for applying SCM can be analyzed by identifying the potential SCM drivers in the industry and determining how significant these drivers are in influencing marketing decisions at present and in the future. The motivations driving SCM can be classified into four major categories and they are:

1. Economics Rationality/Efficiency Motives
2. Investment/Structural Restraints
3. Strategic Management Motives
4. Risk Reduction Motives

The **economics rationality/efficiency motives** are the general concerns for reducing production costs and increasing producer profits. The **investment/structural restraints** are the constraints related to asset and product specificity or exogenous factors such as the market structure resulting from historical development, government and industry regulations, societal expectations and standards on product quality. The **strategic management motives** are firms' decisions to create entry barriers to reduce competition and increase monopolistic profits or to share information to increase consumer responsiveness. The **risk reduction motives** are concerns for maintaining consistency in resource supply as well as consumer demand and product quality. Table 2-1 provides a list of SCM drivers grouped under each of these motivation categories. It indicates the economic theories that can be applied to the study of these SCM drivers. For instance, the table indicates that when considering asset specificity as the key SCM driver, one can apply and test the validity of the rationale using transaction costs economic theory or using a resource-base view of strategic management theory. Also, one can apply the industrial organization theory by checking whether there is an increase in market concentration.

The investigation of SCM as an alternative for the Canadian feed barley marketing system can begin from a scrutiny of the historical and current development of barley marketing in Canada. This includes a brief review of the roles of marketing institutions in barley industry and recent developments in feed evaluation technology. The review of barley marketing in Canada provides the background for a discussion on what are the motivations that may evolve and drive the industry to increase the use of contracts or SCM. The review also helps identify the constraints that may keep the industry participants from contracting or considering SCM.

Table 2- 1 Driver-Theory Table

Supply Chain Management Drivers	Transaction Cost Economic Theory	Industrial Organization Theory	Game Theory	Strategic Management Theory	
				Institutional theory	**Resource-base view**
Economics Rationality/ Efficiency Motives					
Production/Marketing Cost Reduction	✓	✓	✓	✓	✓
Profit Maximization	✓	✓	✓	✓	✓
Investment/Structural Restraints					
Institutional restraints				✓	
Social norm restraints				✓	
Historical development restraints				✓	
Asset specificity	✓	✓			✓
Product specificity	✓				✓
Strategic Management Motives					
Create entry barriers		✓	✓		✓
Reduce competition		✓	✓		✓
Create monopolistic profits		✓	✓		✓
Increase consumer responsiveness		✓			✓
Risk Reduction Motives					
Maintain consistent/desirable product quality	✓	✓			
Maintain consistent supply/demand	✓	✓			

CHAPTER THREE: Barley Marketing in Canada

3.1 Introduction

Canada is a major barley exporter in the world market, ranking second to the European Union as a top exporter of both feed and malting barley (Schmitz et al. 1997). Over the period of 1989 to 1998, Canada on average produced 12.74 million tonnes each year, accounting for about 8% of global production (Canadian Wheat Board 1998).

The barley market in Canada is a "dual" marketing system due to the historical development of government policies. For the Western Canadian provinces (British Columbia, Alberta, Saskatchewan and Manitoba), the export of barley is solely marketed by a government marketing agency, the Canadian Wheat Board (CWB). The domestic consumption of feed barley has been deregulated and fully operated as an open market since 1974. Along with the open market, a futures market for western feed barley trades at the Winnipeg Commodity Exchange.

Canada sells two types of barley, feed and malting. Of the total barley production, 90% is used as feed and the residual 10% is selected as malt for human consumption (KenAgra Management Services 1996). While 90% of the barley produced is put to feed uses, growers on the Canadian prairies have demonstrated a preference for growing malting barley varieties. Malting barley varieties have accounted for 70% of the total barley acreage over the past 50 years (Canadian Grain Commission 1997c). Carter (1993) suggests that farmers prefer growing malting barley because malting barley has on average a price premium of 60% to 70% over the price of feed barley.

In Western Canada, barley is a dominant feed grain in beef and dairy cattle and hog rations. Livestock rations account for more than 60% of total barley production usage each year (Agriculture and Agri-Food Canada 1996).

This chapter provides background information about barley marketing in Canada, which includes:

1) an overview of the history of barley marketing in Canada;
2) roles of institutions in the barley industry;
3) statistics on barley production, varieties and exports;
4) concentration ratios in the barley, livestock and poultry industries;
5) a summary of feed barley demand by the livestock industry;
6) recent developments on defining and measuring the quality of feed grains; and
7) a discussion of SCM drivers for the Canadian feed barley industry.

3.2 The History of Barley Marketing in Canada

This section briefly reviews the history of barley marketing in Western Canada[2]. The history of barley trading in Canada dates back to 1887 when the Winnipeg Grain and Produce Exchange was found. Initially barley was traded only on a cash basis until 1913, when the first barley futures contract was established. By 1923, prairie producer power began to emerge in the form of Wheat Pools. In many ways the Wheat Pools were a political statement about one desk marketing since prairie farmers perceived that middlemen and futures marketing mechanisms were excessively unstable and subject to manipulation by industries (KenAgra Management Services 1981).

Due to the war, the Board of Grain Supervisors marketed all wheat grown in 1917 and 1918. To assist transition to peace-time conditions, the federal government established the Canadian Wheat Board (CWB) to market the 1919 Prairie wheat crop. The CWB implemented a two payment system, an initial payment when the producers delivered the crop to the elevators and a final payment after the financial results of the crop sale were determined. The CWB was disbanded in 1920. However, farmers throughout Western Canada supported the concept of price pooling. Wheat Pools were created in each of the three Prairie provinces and operated an initial and final price mechanism. In 1930, when the Pools fell into financial difficulty as a result of international prices dropping below the 1929 initial price advance, provincial governments intervened. Bank loans were guaranteed and governments assumed responsibility for selling the 1930 crop and providing price support. By 1935 as a result of its price support role, the federal government, with encouragement from producer organizations, reconstituted the CWB. The objectives of the Board were to provide income protection to producers by establishing a government guaranteed floor price for wheat and the opportunity for price pooling. When established in 1935, the CWB was voluntary and producers had the option to designate wheat to the CWB or to a private firm. However, in 1943, when rapidly rising wheat prices threatened the governments' wage and price control policy, Ottawa made it compulsory to market wheat through the CWB.

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[2] Most of the information is based on the KenAgra Management Service study (1981), "Barley Marketing in Western Canada" and also referenced to "the History of CWB" on the web-site maintained by CWB.

Nine years before oats and barley were placed under Wheat Board control in 1949, the Federal Government was already involved heavily in the feed grain system (KenAgra Management Services 1981). The involvement included

1. diverting land from wheat to coarse grains in 1941, 1942 and 1943; and
2. promoting the expansion of coarse grain acreage to encourage a build-up in feed grain stocks.

In 1941, the first barley export controls were instituted to ensure retention of sufficient stocks to expand livestock production and fill meat contracts to the United Kingdom. During the period of 1942 to 1947, wartime price ceilings were placed on barley to maintain price relationships between feed grains and livestock. On the other hand, price support was instituted for barley and oats from 1942 until 1949. In addition to the upper and lower limits, the government introduced export equalization fees in 1943 in order to equalize domestic prices with export prices.

In March 1947 the CWB, under authority of an order in Council, took possession of all oats and barley in commercial positions, and became the sole exporter. In 1948 the

Board became responsible for inter-provincial marketing as well. While a Dominion Coarse Grains Bill of 1948 made the federal government sole marketing agent for oats and barley, it was not proclaimed until the Prairie governments enacted complementary legislation. Saskatchewan immediately provided concurrent provincial legislation while Alberta and Manitoba sought a guarantee from the federal government that the CWB, in handling coarse grains, would act in the interest of producers, not as a government agency. Alberta and Manitoba both held a plebiscite and found that most producers preferred marketing oats and barley through the CWB. Alberta and Manitoba passed an Act following Saskatchewan in 1949.

Although the Wheat Board solicitors interpreted the act to include Wheat Board control over inter-provincial trade within the Prairies, the CWB experienced difficulties in obtaining compliance. Grain trade personnel urged that the feed grains be allowed to move freely across provincial borders within the prairies. The restriction on inter-provincial marketing within the Prairies was later removed in 1960.

After the Board had taken over responsibility for barley, it continued to sell to grain dealers. The use of Winnipeg Futures was discontinued by the CWB in the early 60's. During that time, the CWB introduced policies to deal with problems of adequacy of feed grain supplies in Central Canada and to restrict the amount of price variation. It was able to retain the support of many producers and the users of the feed grains. However, in 1969, the Board was accused of taking advantage of Eastern users, providing undue advantage to Western producers. This was because the Board continued to price in the domestic market in competition with US corn, while adopting a more aggressive (price discounting) policy in the export area. This created a two price system with domestic Eastern Canadian buyers paying the higher price. At the same time uncontrolled intra farmer sales in the Prairies took place at prices far below those charged to Eastern buyers.

The divergences in prices at different locations led to the introduction of the Interim Domestic Feed Grain Policy in 1973. The objectives of the policy were

1) to provide a fair and equitable base price for feed grains across Canada;
2) to provide relief for the producer against depressed feed grain prices; and
3) to encourage the growth of livestock and feed grains across Canada.

Although some organizations expressed support for greater regulation in the market, the Canadian government rejected the idea of a plan, which would prohibit prairie grain producers from selling their grain to feed mills, feedlots or the neighbors. Nevertheless, the policies introduced during the 1974/75 crop year included:

1. Recommencement of trading in domestic feed grains on the Winnipeg Commodity Exchange with elevator companies on the Prairies to purchase and sell feed grains in the domestic market throughout Canada;
2. Permission for the CWB to impose quotas on deliveries of non-Board grains and switching of grain at will between owners of grain between Thunder Bay and Western destinations;
3. Retention of the CWB as the sole purchaser and seller of feed grains for the export market;
4. Provision for a $40 million grain storage program to ensure a reliable grain supply to Eastern users at costs borne by Canadians;
5. A guarantee of a minimum return to the producer from sales into the domestic market at the level of the initial price of sales to the Board; and
6. An increase in the cash advance system to $15,000 for each producer, with the advance to be applicable to barley quotas.

As a result of the policies, the government created a "dual" marketing system for barley, which continues to the present time, allowing producers to sell barley either through domestic spot markets or to export markets through the CWB.

In addition, transportation of western grains under the Crowsnest Pass Agreement in 1896 was regulated by a regime of low freight rates. By 1970's, the system became unsustainable. The government intervened with provision of a large number of grain hopper cars and with a program of government-financed prairie branch line rehabilitation.

In 1983, the Western Grain Transportation Act was established to introduce a system of rail rates that are partly paid by grain producers and partly through government subsidies. These export subsidies may have increased the domestic prices of barley. By 1995, the government subsidies were eliminated in compliance with international trade agreements.

3.3 Roles of Institutions in the Canadian Barley Industry

This section gives an overview of the roles of institutions in the Canadian barley industry. These institutions, namely, are Winnipeg Commodity Exchange, Canadian Grain Commission, Canadian Wheat Board, and Canadian International Grains Institute. The information about the structure, objectives and responsibilities of these institutions is extracted from the web-site maintained by each of these institutions. The objectives and responsibilities of these institutions reveal that the Canadian government is actively playing a role in financing, marketing, managing price risk and setting the industry standard for production practices and quality assurance.

3.3.1 Winnipeg Commodity Exchange

The Winnipeg Commodity Exchange (WCE) was originally established as the Winnipeg Grain and Produce Exchange in 1887 and incorporated in 1891. The WCE is a self-governing non-profit organization. It is governed by a 16-member Board of Governors, including three non-members (public governors) and the President and the CEO. The regulation of the WCE and the WCE Clearing Corporation (established in 1998) is being transferred from the Canadian Grain Commission (CGC) to the Manitoba Securities Commission.

The Exchange:

- provides facilities for futures, cash and options trading in feed wheat, feed barley, peas, canola, oats and flaxseed;

- does not buy or sell grain or futures, but sets the conditions under which trading in grain can be conducted by its membership;
- has a prime function of price discovery;
- provides news and price information from other markets to its membership and communicates prices from its trading floor world-wide; and
- arbitrates disputes and investigates complaints.

To facilitate trading, it is necessary to specify the price, delivery time, amount and a set of physical characteristics for each commodity in the futures contract. The seller of the contract has the option of taking physical delivery on maturity. This may influence sellers to produce commodities that are closer to the trading standard and place higher emphasis on physical characteristics for the convenience of visual checking. The norm of trading standardized products will decrease the potential for SCM in the industry.

3.3.2 Canadian Grain Commission

Originally established as Board of Grain Commissioners in 1912 and renamed the Canadian Grain Commission (CGC) in 1971, the CGC's regulation of the system has been a critical component in Canada's grains exports. The primary focus of the CGC is on the control of grain quality from the farm to the customer. The legislation and regulations ensure fair grades and dockage assessment, together with accurate weights for buyer and seller.

The CGC is responsible for:

- establishing grain standards and setting minimum quality standards re varietal licensing;
- regulating elevators and grain dealers, requiring a bond against possible financial failure;
- regulating grain inspection and weighing (all sampling, grading, dockage assessment, weighing, storing and shipping);

- issuing the "certificate final" for the buyer guaranteeing the grain's weight and grade;
- supervising futures trading on the WCE although this task has recently been transferred to the Manitoba Securities Commission;
- conducting both applied and basic research on the quality of a variety of grains; and
- allocating producer cars.

The CGC has played a very important role in directing and defining both the physical and quality characteristics of the grain production in Canada. It has the authority to inspect, approve and assign the grades, which directly determine the prices of the grains. Although the practice does not apply to the domestic feed barley, the CGC grades for feed barley exports may set guidelines to the domestic market. The CGC grading places strong emphasis on readily identifiable characteristics like weight and dockage, which facilitate barley trading more efficiently in open market system and decrease the potential for developing SCM.

3.3.3 Canadian Wheat Board

The Canadian Wheat Board (CWB) was first established in 1919, disbanded in 1920 and reconstituted in1935. It is responsible for marketing all wheat and barley in the prairies destined for export or for human consumption in Canada. The CWB is led by a 15-member Board of Directors, including 10 elected farmers and five directors appointed by Governor-In-Council based on their business expertise.

The major objectives of the CWB are:

- to maximize producers returns;
- to provide producers with guaranteed initial payments and to pool returns, distributing any surplus funds after payment of Board expenses so that all producers realize the same return for the same grade of grain, net of primary

elevator and cleaning costs and transportation to the nearest designated base point; and
- to equalize producer delivery opportunities by regulating the flow of grain from the farm to export position.

To achieve its objectives, the CWB:
- markets to domestic, US and offshore customers;
- sends market signals to producers through initial pricing, pool return outlooks, and other detailed market information;
- directs movement of Board gains through delivery quotas and contracts;
- monitors international and domestic market conditions; and
- allocates shipping orders for rail cars to companies handling Board grains.

Although the targeted customers of the CWB are export markets, the actions of CWB has great influence on the domestic feed barley market (KenAgra Management Service 1996). The CWB influences domestic feed supplies, feed prices and feed quality.

3.3.4 Canadian International Grains Institute

The Canadian International Grains Institute (CIGI) was created in 1972 as a non-profit, educational facility offering instruction in grain handling and transportation, marketing and technology. CIGI programs emphasize on commercial practices. Of particular interest are the pilot flourmill, bakery and noodle plant used to test the suitability of various grains and/or new processes. The Institute's work is done in cooperation with the Grain Research Laboratory of the CGC and focuses on uses of Canadian grains in products consumed throughout the world.

CIGI has been used as a market development tool to :
- educate foreign customers on the benefits of Canadian grain;
- provide courses on grain handling, marketing and technology;

- test the suitability of grains for processing; and
- evaluate new processing technologies.

The objective of the CIGI is to work closely with grain customers to promote the quality of Canadian grain as well as test and evaluate the suitability of various grains. The CIGI can be seen as an organization to increase customer responsiveness. The CIGI may promote some forms of strategic alliances in grains supply chains and improve product quality or the design of new products. However, the CIGI explores opportunities only for export markets. A similar organization to facilitate the domestic feed barley market might increase the potential of applying SCM between the livestock and feed barley industries.

3.4 Barley Statistics, Canada

This section gives an overview of the barley statistics, which mainly documents the barley acreage, production, varieties and exports. Since 90% of the barley production comes from Alberta, Saskatchewan and Manitoba, highlights are made specifically to the Prairie region.

3.4.1 Barley Acreage, Canada

Barley grows well in Canada, especially in the prairies. Approximately 13% of all cultivated land in Canada is put under barley production annually. In the world market, Canada is a top exporter of both feed and malting barley, ranking second to the European Union (Schmitz et al. 1997).

The amount of land allocated to barley production in Canada varies from province to province and from one crop year to the next. Canadian barley production is concentrated in the Prairie provinces and on average, Alberta has the largest acreage in barley production. Alberta accounts for 45% of the total Canadian barley production acreage, followed by Saskatchewan (34%) and Manitoba (11%). Over the last decade, these three provinces have averaged about four million hectares of land per year put into barley production. In all, Western Canada accounts for 90% of all land cultivated for barley production (Table 3-1). The barley acreage declined between 1989 and 1992. However, acreage recovered during the 1990's, peaking in 1996 (Figure 3-1).

3.4.2 Barley Production, Canada

Globally, between 143 – 179 million tonnes of barley is produced annually and Canada's contribution to the global production ranges between 6 – 10%, or 10.3 – 15.6 million tonnes. Over the period from 1989 to 1998, Canada produced an average of 12.74 million tonnes annually, accounting for about 8% of the global production (Canadian Wheat Board 1998). Of the 12.74 million tonnes, Alberta accounts for 47% of the Canadian barley production; followed by Saskatchewan at 31%, and Manitoba at 12.4% (Table 3-2). Together they contribute 90% of the total barley grain production in Canada (Table 3-2). The average cash receipts from barley production were 4.73% ($254 million), 4.71% ($235 million) and 2.67% ($63 million) of the provincial cash receipts from farm products[3] for Alberta, Saskatchewan and Manitoba respectively (Table 3-3).

3.4.3 Barley Varieties, Canada

Canada sells two types of barley, feed and malting barley. About 90% of the barley produced is used as feed and the residual 10% as malt for human consumption (KenAgra Management Services 1996)[4]. While 90% of the barley produced is put to feed uses, growers on the Canadian prairies have demonstrated a preference for growing malting barley varieties, which have accounted for 70% of the total barley acreage over the past 50 years (Canadian Grain Commission 1997c).

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[3] Farm products include crops, livestock and products, and direct payments

[4] In 1998, 2/3 of total acreage was seeded as malt and only 12% of the total barley production was selected as malt quality (CWB annual report 1997-98).

Malt is an essential ingredient for beer making and malting barley receives a premium price. On average about 15% to 20% of malting barley production is graded as malt (Carter 1993). The unselected malting barley varieties are either consumed as domestic feed or exported to feed markets.

There are six-row and two-row barley varieties. Six-row barley in Canada was historically the preferred variety because high tariffs at the turn of the century eliminated the two-row malting barley market in eastern United States. Also, the traditional two-row growing regions in eastern Canada (along Lake Ontario) have been taken over by alternative land uses (Agriculture and Agri-Food Canada 1997). Between 1910 and 1965, six-row malting varieties accounted for about 90% of the malting barley grown in Western Canada. However, with the release of improved two-row barley selections, particularly Harrington, two-row malting barley predominates in Alberta and Western Saskatchewan. The B1602, Robust and Excel, which are six-row malting barley originated from the US and designated as 'white aleurone', have higher barley acreage in Manitoba (Canadian Grain Commission 1997c).

Table 3-4 compares the areas seeded to two-row and six-row malting barley cultivars in Western Canada. It shows that almost two thirds of the area seeded to malting barley is two-row varieties, of which on average over 40% belongs to the Harrington cultivar. The two-row malting barley production has expanded rapidly since the 1970s partly because over these years, more two-row varieties are traded worldwide, and partly because the new two-row barley varieties had improved malting and agronomic performance (Agriculture and Agri-Food Canada 1999).

In Canada, there are many cultivars for both two-row and six-row barley varieties (Tables 3-5 and 3-6). Barley cultivars are registered and evaluated by government agencies to obtain information such as yield, kernel weight, and variety disease resistance. Two-row varieties are often preferred by feedlots due to two-row's larger kernel and bushel weight. Most two-row varieties are malt types, which have poor disease resistance (AAFRD 1999b).

Some barley varieties are classified as hulless barley. The interest in the use of hulless barley as a feed has continued to increase. The demand for hulless barley in Canada has been mainly from feed mills and on-farm feed-mixers on the prairies. The feed mixes using hulless barley are mostly sold to the hog industry (Canadian Grain Commission 1997d).

3.4.4 Canadian Barley Exports

Canada, is the second largest barley exporter in the world and accounts for 7.7% of the barley production of the major producing countries. Only about 15 million tonnes of barley are traded annually (Canadian Wheat Board 1998). Canada exported more barley in the 1980s than in the 1990s. According to Statistics Canada, in the period of 1986-1987 Canada exported 6.53 million tonnes and since then it has not exported barley in excess of 4.5 million tonnes (Figure 3-2). The exports for the period of 1997-1998 were 2.13 million tonnes (Table 3-7), which is only 32.5% of the 1986-1987 levels.

For the period of 1997-1998, Canada exported more malting than feed barley (Table 3-8). About 40% of the total barley exports were feed barley, of which only 10% was consumed in the Western Hemisphere. The rest was exported to Africa and Asia. Saudi Arabia was the largest importer of Canadian feed barley, accounting for 46% of the total feed barley exports, followed by Japan, which accounts for 24%. Of the total malting barley exports, 47% went to the US and 44% to China.

There are several barley export exit points in Canada but most barley is exported through Vancouver and Prince Rupert. On average, these two exit points account for 70% of export barley traffic because they provide a shorter and less expensive route to major export markets such as Japan, the People's Republic of China, South Korea and some nations in the Western Hemisphere (Argentina, Ecuador, Mexico and the US). The eastern route is more costly because it involves railway transportation from the Western provinces to the East. Barley exported through the east exit is almost exclusively to the Middle East countries (Table 3-9). Canada does not have any barley trade with Europe for the reason that Canada's barley cannot compete with Australia's high quality feed barley and the European Union produces high quality two-row malting barley (KenAgra Management Services 1996). On average, Canada's share of the world barley market was in the range of 16 - 20% over the period of 1989-1998 (Table 3-10).

3.5 The Market Structure and the Concentration Ratios of Feed Barley, Livestock and Poultry Markets in Canada

This section presents the market structure and approximate market concentration ratios in the feed barley, livestock and poultry markets in Canada. A common measure is the four-firm sales concentration ratio (CR_4), a ratio of the sales for the four largest companies to the total market (Scherer and Ross 1990). If the CR_4 is higher than 75%, it reflects an oligopoly that is very concentrated, while a CR_4 of below 25% indicates the market structure is more likely to be competitive.

The figures used to present the concentration ratios for feed barley, livestock and poultry markets are derived from the "Historical Overview of Canadian Agriculture" published by Statistics Canada (1996b). It is assumed that the production figures are a reasonable proxy for the sales figures. As well, the production figures for the barley and livestock industry are assumed to be reasonably represented by the average barley acreage and number of animals per farm.

Census data (Table 3-11) show the number of farms reporting barley production in 1996 was down 20.8% and the average barley acreage per farm was up 30.9%. There is a trend of increasing farm sizes for growing barley (Table 3-12). Nevertheless, the percentage distribution still remains highly concentrated in the smaller farm sizes. Over the period of 1976 to 1996, more than 90% of farms reported less than 448 acres in barley production. The smallest category accounts for about 47% of the total barley acreage, which indicates that the CR_4 ratio is well below 75%. Based on the market structure, barley farms are unlikely to exhibit any market power in the barley market. Similar analyses of the pork, beef and laying hen markets (Tables 3-13 to 3-18) indicate that the largest four producers in each of these livestock and poultry industries have captured less than 25% of the sales in the markets. Therefore, it is unlikely that livestock producers have any market power in the livestock markets or in the feed barley market.

The feed mill industry is one of the key players in the Canadian barley supply chain. It adds value to feed grains. Besides cleaning and processing grains, some feed mills add nutritional components into feed for livestock and poultry. The market structure and the concentration of this industry are investigated in the survey through direct interviews, which are reported later in chapter six.

3.6 Feed Barley Demand by Beef and Dairy, Hog and Poultry Industries

In general, there is a consensus view that grain is used in animal feeds because it is a major and economical source of energy and protein. The major feed grains (corn, barley, wheat, sorghum and rye) vary in their energy and protein contents. These differences in energy and protein levels explain why different grains have different prices (Hickling 1995).

In Canada, 90% of the barley production is located in Western Canada. In the period of 1992-1997, on average 50% of the barley was marketed by CWB and the other 50% was sold in the cash markets for feed (Canadian Grain Commission, 1997a). Table 3-19 shows the Canadian livestock and poultry feed use by feed grain types, which indicates that the amount of barley consumed domestically has steadily increased over last several years. Barley accounts for 37% of the total feed use.

Beef and dairy cattle rations accounted for more than 75% of total domestic barley consumption in Western Canada (Agriculture and Agri-Food Canada, 1996). The hog sector falls into second place after beef cattle as the largest consumer of feed barley and accounted for 22% of total domestic barley consumption in Western Canada (Agriculture and Agri-Food Canada, 1996). Barley and corn are the major feed grains used in feeding hogs. In Western Canada, hog rations normally consist of 60 to 85% barley (Agriculture and Agri-Food Canada, 1996).

Wheat and corn are the major feed grains used for poultry. Barley's high beta glucan content causes digestibility and wet litter problems in young fowl. Barley however is included in poultry feed because it provides special enzymes that can help correct nutritional limitations and also because barley is relatively inexpensive (Agriculture and Agri-Food Canada, 1996).

3. 7 The Recent Development on Defining Feed Quality of Barley

Advanced feed evaluation technology in Canada has made the analysis of feed quality more reliable and less time-consuming (Edney 1998). Traditionally, digestibility trials for feed evaluation are used as the basis for expressing nutrient contents. Proximate analysis, a chemical system for measuring feed quality is still widely used around the world (Edney 1998). This system describes feedstuffs in terms of moisture, crude fibre, crude protein, extract, ash and nitrogen-free extract. Tables showing average composition of feedstuffs in terms of these six components have been published in North America and Europe. Nevertheless, systems for using these feed tables have varied around the world. Distinct systems evolved because of different animal types. For instance, monogastrics and ruminants have different abilities to use the six feed components (Edney 1998).

Proximate analysis is the most common analysis for feed evaluation. This method gives a good general evaluation of feed. Most data reported in feed tables continues to be reported in terms of proximate analysis. The equipment required for the analyses are relatively unsophisticated and inexpensive, but there are several disadvantages of using this system and they are (Edney 1998):

1. individual nutrients are not defined;
2. the analyses are time consuming and are not accurate;
3. the system gives no information on digestibility and the information provided is of limited value.

As a result of the shortcomings, the components: crude fibre, crude protein and nitrogen-free extract have been replaced respectively by neutral- and acid-detergent fibre, analysis of individual amino acids and analysis for starch and individual sugars. As well precise methods for determination of micro-and macro-nutrients, such as minerals, have been developed and provide information not available from a simple ash analysis (Edney 1998).

The traditional method (i.e. the Kjeldahl method) for analyzing protein is slowly being replaced by methods based on the Dumas principle (Edney 1998). The Kjeldahl analysis was time-consuming, labour-intensive, and dangerous, and it produced large amounts of chemical residues. Currently, feed formulations use exact amino acid requirements for animals as well as information on levels of amino acids in feedstuffs (Edney 1998). High-Performance Liquid Chromatography (HPLC) is the standard method for analyzing amino acids and has remained relatively constant in methods.(Edney 1998). Technical advances have made synthetic amino acids cheaply available for use in feed rations.

Digestibility and availability of nutrients has received increased research attention, as feed formulation has become more sophisticated (Edney 1998). The accessibility to synthetic amino acids has been especially important in increasing the need for digestibility values for amino acids. The energy value of a feedstuff remains the most important consideration in feed evaluation and digestibility methods have always concentrated on its measurement. Energy content of feeds is important because animals tend to consume feed until their energy requirements are met. Therefore, all other nutrients in diets are expressed at concentrations related to the energy contents of the diet.

Although today's feeding trials are more sophisticated, they still have some problems (Edney 1998). There is variability in performance among individual animals resulting in a need for large numbers of animals on test. Feed trials are still very time-consuming, as there is an increasing need for a great amount of information on test ingredients. This increases the expense of feeding trials. There are other methods for feed value testing such as in situ and in vitro digestibility techniques that measure the digestion rate of dry matter, starch and the production response of animals. The in situ testing is more accepted and is effective in cattle and pigs (de Boer et al. 1987; de Lange et al. 1991). The in vitro testing used for ruminants and monogastrics is considered to be consistent with animal performance, much quicker and cheaper than feeding trials (Edney 1998).

Near infrared reflectance (NIR) technology has been used for feed evaluation for over 25 years. It is appealing to feed evaluation because it is quick, inexpensive and non-destructive. NIR has been the method of choice in the grain industry and used commercially to predict moisture and protein. In the feed area, NIR tests are capable of predicting fibre and energy contents of corn (Valdes and Leeson 1992) and barley (Edney et al. 1996). NIR tests are also capable of predicting amino acid contents (Williams et al. 1984). Research has shown that NIR technology is able to predict the digestibilities of amino acids (van Kempen and Jackson 1996). NIR technology has the potential to provide quick and accurate feed tests.

The potential for sophisticated feed evaluation in the future is increasing (Edney 1998). There is image analysis that can give details on size and shape distributions of kernels in a barley sample. There is the Single Kernel Characterization System (SKCS) which gives information on moisture, weight, protein and hardness of individual kernels in a grain sample. There is microscopy feed evaluation where both macro- and micro-parameters can be investigated (Edney 1998). Finally, there are methods for variety ID, both protein and DNA, which may be the analysis of most importance to the feed industry where the identification of new transgenic feed ingredients with special qualities may be required[5].

3.8 SCM Drivers for the Canadian Feed Barley Industry

The motivations driving the barley market towards SCM can be classified into four categories and they are:

1. Economics Rationality/Efficiency Motives
2. Investment/Structural Restraints
3. Strategic Management Motives
4. Risk Reduction Motives

The review of Canadian barley marketing system is combined with the analysis from Chapter 2 to evaluate SCM in the barley market. The relevant SCM drivers are identified and used to discuss whether they lead to SCM or an open market system.

3.8.1 The Economics Rationality / Efficiency Motives

The economics rationality/efficiency motives are general concerns for reducing production or marketing costs and increasing producer profits. Research effort has been put into analyzing feed efficiency for livestock and poultry with respect to various types of barley. There are results showing differences in the cost between barley samples. For instance, Zijlstra et al (1997) analyzed 40 barley samples for the digestible energy content based on a grower pigs diet. Each diet contained a minimum of 45% barley. The results show the value of the barley samples varied from $78 to $139 per 1000 kg. Cost-reducing varieties developed through advanced breeding practices and genetic engineering are seen as offering potential for SCM (Hobbs and Young 1999). Co-ordination between livestock and barley producers for contracting a particular barley cultivar that yields the lowest feed cost is likely to be driven by the economic rationality/efficiency motives. Development of specific feed varieties with livestock specific traits is a potential driver of SCM.

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[5] The Canada Alberta Beef Industry Development Fund has contributed to a study to package enzymes into "transgenic" barley plants which can be fed as forage to cattle. The enzymes are expected to enhance feed efficiency and weight gains in cattle (Alberta Cattle Commission -*Grass Routes* special edition August 1998)

3.8.2 The Investment / Structural Restraints

The investment/structural restraints are the constraints related to asset and product specificity or to exogenous factors such as the market structure resulting from historical development, government and industry regulations, societal expectations like rules, norms, and standards about the product quality. For the Canadian feed barley industry asset specificity does not seem applicable as the major farming investment is in land and farming machinery, which are not highly specific for barley production. It is easy for farmers to switch land to other crops, like canola or oats. For beef feedlots, dairy, pork and poultry farms, asset specificity is high since the investment in animal housing has low value in alternative uses. In addition, the investments necessary to take advantage of economies of size are substantial for some livestock industries such as hog production (Martinez and Zering 1997). High asset specificity may create incentive for VC (Hobbs 1997; Martinez et al. 1997). However, the driver is in the livestock sector and not in the feed barley production sector.

As for product specificity, the advancement in feed evaluation that allows more sophisticated testing on the feeding value of different barley cultivars (Edney 1998), is likely to help differentiate the products in the feed industry. Research on the feeding value of barley in specific types of animals may also differentiate products in the feed industry (Khorasani et al.1997; Zijlstra et al. 1997). Research on targeted barley varieties that can give the feed an economic advantage to the producer, feed processor and livestock producer, is proposed to be a strategy needed to sustain the competitive position of barley as a feed (Racz 1998). The concept of developing targeted barley varieties is likely to increase the degree of product specificity in feed barley transactions. According to several SCM/VC studies (Hobbs and Young 1999, 1997, 1996; Kennett 1997; Hennessy 1996), a high degree of product specificity is likely to cause some forms of co-ordination along the supply chain to minimize transaction costs. However, low cost, accurate and quick feed tests would decrease the need for VC.

Although research in feed value for barley has been carried out extensively and the findings offer potential to differentiate barley varieties into targeted feeds for the livestock and poultry industries, there are several structural restraints in the Canadian barley industry. First, the malting barley market has strongly influenced the feed barley market in production acreage and the varieties selected for production. Due to a high price premium for malting barley, on average 70% of the total barley production is allocated to malt barley varieties (Canadian Grain Commission, Grain Research Laboratory, 1997). Only 20% of malt barley varieties grown are selected or sold as malting barley. The rest are sold in the feed barley market (KenAgra Management Services 1996; Carter 1994). As a result, the feed barley market is filled with malt barley varieties not specifically designed as feeds. Various institutions such as the CGC and the CWB likely contribute to wide spread use of malt varieties. This situation will remain unless the expected return for growing feed barley becomes equal to that for growing malting barley[6] or barley marketing institutions change.

Second, feed barley exports and malt barley marketing in Canada are controlled by government agencies/marketing boards. Although the domestic feed barley market operates in an open market, the marketing agencies influence prices and supply in the domestic market (KenAgra Management Services 1996). The institutions and/or their policies may reduce the incentives to vertically coordinate between the barley and livestock industry. Third, the objectives and responsibilities of the institutions in Canadian barley marketing have strongly committed to setting the industry standard for production practices and maintaining a single grading system. For decades, CWB has emphasized the marketing strategy of maintaining consistency of quality, which is based on physical characteristics of barley. Despite the research efforts to determine the feeding value of barley, conformity to a single grading system will discourage product differentiation in the industry.

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[6] The expected return for growing malting barley is equal to: (Probability of accepted as malt) x (Price of malting barley) + (Probability of rejected for malt) x (Price of feed barley)

There are changes in other countries' government policies and regulations that may eventually affect the regulatory environments of the Canadian agri-food industries. Concerns about consumer confidence in food safety have resulted in government regulations that look for more traceability in agricultural supply chains. For instance, the 1990 Food Safety Act in UK has increased the legal liability of food firms causing them to seek more information about upstream production practices in the food supply chains (Hobbs and Young 1999). The Food Standards Agency report in 1997 advocated the creation of an independent body to oversee the entire food production process in the UK (Wilson and Clarke 1998). Also, in December 1998, the EU endorsed plans to extend product liability laws to farmers (Hobbs and Young 1999). These changes in regulatory environment are considered a driver for some forms of VC to establish information-sharing systems in agricultural supply chains (Hobbs and Young 1999; Wilson and Clarke 1998). In Canada, a cattle identification program to enhance trace-back capabilities in the Canadian beef industry is to be introduced by January 2001. All cattle are to be tagged with an approved Canadian Cattle Identification Agency ear tag when leaving their herd of origin (Canadian Cattlemen's Association 2000). Livestock producers in the future may be required to provide details on all key inputs into the livestock. This may include the management practices used to produce the barley.

3.8.3 The Strategic Management Motives

The strategic management motives are firms' decisions to create entry barriers to reduce competition and increase monopolistic profits or to share information to increase consumer responsiveness. The motives to create entry barriers, reduce competition and create monopoly profits do not seem applicable in the Canadian feed barley industry. There are a large number of barley farmers and livestock producers (as discussed in section 3.5). Monopolizing an input supply to create entry barriers, reduce competition or create monopoly profits does not seem possible. Nevertheless, the motive to increase consumer responsiveness is likely to arise in the feed industry as the advancement in feed evaluation makes it possible to define the feeding value of barley. This motive has already drawn attention in the research of targeted barley varieties that respond to the need of livestock producers. The success of finding targeted barley varieties may increase the potential for SCM between the feed barley and livestock industries.

3.8.4 The Risk Reduction Motives

The risk reduction motives are concerns for maintaining consistency in resource supply as well as consumer demand and product quality. Beef feedlots in Western Canada are users of feed barley on a daily basis. They cannot reduce barley consumption in the short term and often bear the risk of price fluctuation or supply inconsistency (KenAgra Management Services 1996). A long-term contracting relationship between barley farmers and the feedlots for feed barley supply can reduce the price and supply risk for the feedlots. However, KenAgra (1996) suggests that most farmers prefer to grow malting barley and bear the risk of uncertainty of acceptance due to the price premium of malting barley. Under the current marketing system, the domestic feed barley supply is strongly influenced by the malting barley market. As the feed barley market continues to be inseparable from the malting barley market, barley farmers may not be willing to guarantee feed barley supply through contracting, unless the expected return of a targeted feed barley variety yields a higher (or at least the same) expected return as growing malting barley.

3.9 Conclusion

This chapter has reviewed the Canadian barley marketing system and provided a discussion of SCM drivers for the Canadian feed barley industry. In summary, the potential SCM drivers identified for the Canadian feed barley industry are the motivations for:

1. contracting specific barley varieties for specific feed rations;
2. reducing the cost of searching for feed barley of high feeding value;
3. maintaining consistent supply of feed barley due to short-term inelastic demand;
4. increasing control of input resources to secure the high asset specificity in livestock production; and
5. establishing information sharing system to enhance customer responsiveness and traceability of products to increase consumer confidence in food safety.

On the other hand, the structural constraints that drive for open market system are:

1. high number of players in both the barley and the livestock industries;
2. government policies that emphasize standardization of grain quality based on readily identifiable visual characteristics;
3. feed barley market being inseparable from the malting barley market;
4. non-specific assets for investments in barley production;
5. high environmental variability in barley production; and
6. improvements in feed testing technology that lead to low cost, accurate and quick feed test results.

This chapter identifies the potential SCM drivers as well as the drivers for an open market system. The potential SCM drivers mostly come from the recent changes in technology and the regulatory environment. The result of these changes may lead to preferences for long term contracts to maintain consistency in supply, preferences for contracting a particular type of barley for specific rations, preferences for a long term buy/sell relationship that emphasizes high traceability of agronomic practices used to grow the barley and so forth. An empirical test for these preferences in the demand for feed barley will indicate whether there is a potential for SCM between the barley and livestock industries.

Table 3- 1 **Area Allocated to Barley Production by Province (in thousand hectares) , Years 1989-98**

Year	P.E.I.	N.S.	N.B.	Quebec	Ontario	Manitoba	Sask.	Alberta	B.C.	Total
1989	32.4	5.7	12.9	142.0	194.2	647.5	1,558.0	2,084.1	50.6	4,727.4
1990	32.4	5.7	12.5	146.0	178.1	607.0	1,436.6	2,063.9	46.5	4,528.7
1991	34.1	5.3	12.8	157.0	197.0	544.5	1,343.2	2,187.1	43.2	4,524.2
1992	35.0	3.6	14.2	160.0	174.0	424.9	1,185.7	1,760.4	32.4	3,790.2
1993	32.8	4.8	16.2	155.0	170.0	465.4	1,618.7	2,063.9	32.4	4,559.2
1994	30.4	4.9	15.4	145.0	141.6	445.2	1,537.8	1,983.0	26.3	4,329.6
1995	32.4	4.5	15.8	130.0	133.5	485.6	1,740.1	2,084.1	28.3	4,654.3
1996	36.7	5.0	16.6	125.0	133.5	627.3	1,902.0	2,347.2	44.5	5,237.8
1997	40.9	6.5	16.2	126.0	137.6	566.6	1,821.1	2,266.2	38.4	5,019.5
1998	38.8	7.0	15.0	130.0	131.5	526.1	1,639.0	2,104.4	40.5	4,632.3
Average	**34.6**	**5.3**	**14.8**	**141.6**	**159.1**	**534.0**	**1,578.2**	**2,094.4**	**39.7**	**4,601.7**

Source: Statistics Canada (1998), "Field Crop Reporting Series", Catalogue 22-022.

Table 3- 2 **Barley Production by Province (in thousand tonnes) , Years 1989-98**

Year	P.E.I.	N.S.	N.B.	Quebec	Ontario	Manitoba	Sask.	Alberta	B.C.	Total
1989	119.7	18.1	45.3	447.0	611.8	1,545.8	3,135.2	5,726.2	135.0	11,784.1
1990	88.1	14.4	38.0	490.0	581.3	1,959.5	3,897.3	6,248.7	124.1	13,441.4
1991	97.0	10.1	32.7	454.0	548.7	1,426.1	3,069.9	5,878.6	100.2	11,617.3
1992	141.2	14.3	51.4	560.0	631.4	1,567.6	3,157.0	4,855.3	53.3	11,031.5
1993	91.7	13.5	45.6	435.0	500.8	1,241.0	4,245.6	6,314.0	84.9	12,972.1
1994	86.9	14.4	36.9	340.0	446.3	1,328.1	3,919.0	5,464.9	55.5	11,692.0
1995	93.7	16.7	42.1	350.0	418.0	1,328.1	4,354.5	6,335.8	93.6	13,032.5
1996	118.4	17.2	56.1	355.0	391.9	2,111.9	5,356.0	7,076.0	79.5	15,562.0
1997	136.3	16.7	52.6	415.0	435.4	1,685.2	4,430.7	6,270.5	84.9	13,527.3
1998	135.9	20.1	40.8	425.0	381.0	1,630.8	4,310.9	5,660.8	103.4	12,708.7
Average	**110.9**	**15.5**	**44.2**	**427.1**	**494.7**	**1,582.4**	**3,987.6**	**5,983.1**	**91.4**	**12,736.9**

Source: Statistics Canada (1998), "Field Crop Reporting Series", Catalogue 22-022.

Table 3- 3 **Cash Receipts from Barley (in thousand dollars) for Alberta, Saskatchewan and Manitoba, Years 1989-98**

	Alberta			**Saskatchewan**			**Manitoba**		
Year	Cash Receipts from Farm Products*	Cash Receipts from Barley	Percentage of Barley Cash Receipts**	Cash Receipts from Farm Products	Cash Receipts from Barley	Percentage of Barley Cash Receipts	Cash Receipts from Farm Products	Cash Receipts from Barley	Percentage of Barley Cash Receipts
1989	4,599,469	351,637	7.65	4,498,721	204,642	4.55	2,108,196	79,131	3.75
1990	4,283,091	226,538	5.29	4.030.819	188.833	4.68	1,985,442	82,387	4.15
1991	4,236,264	195.187	4.61	4.129.842	175,942	4.26	2,005,860	59,238	2.95
1992	4,951,736	163.173	3.30	4.393.210	129.891	2.96	2,167,919	47,039	2.17
1993	5,056,637	165,730	3.28	4.548.430	143,491	3.15	2.387,233	53,261	2.23
1994	5.570,160	224,062	4.02	5.059.837	210,528	4.16	2,460,989	43,309	1.76
1995	5,949,173	301,787	5.07	5,396,959	313,742	5.81	2,523,054	60,705	2.41
1996	6,564,937	433,517	6.60	5,547,572	402,550	7.26	2,815,613	85,329	3.03
1997	6,483,395	284,592	4.39	5,909.798	332,299	5.62	3,032,349	76,743	2.53
1998	6,381,548	194,901	3.05	5,572.547	255,963	4.59	2,848 346	48,714	1.71
10-year average	**5,407,641**	254,112	**4.73**	**4,908.774**	235,788	**4.71**	**2,433,500**	63,586	**2.67**

Source: Statistics Canada, CANSIM 1999.

* Farm Products include crops, livestock and direct payments

** The percentage was calculated as barley's contribution to total cash receipts

Table 3- 4 **Seeded Area of Barley Cultivars (as a Percent of Total Area Seeded to Malting Barley) in Western Canada, Years 1996 and 1997**

Two-row Cultivars	**1997**	**1996**	**1993-97 average**	**Six-row Cultivars**	**1997**	**1996**	**1993-97 average**
Harrington	35.7	40.2	43.3	White aleurone*	31.4	27.3	19.8
Manley	10.0	11.7	14.6	Argyle/Bonanza	4.3	6.5	11.5
AC Oxbow	5.7	5.2	2.5	Tankard	1.4	1.3	1.1
Stein	4.3	3.9	2.5	Duel	--	1.3	1.8
B1215	4.3	2.6	2.0				
Other	2.9	--	0.9				
Total	**62.9**	**63.6**	**65.8**	**Total**	**37.1**	**36.4**	**34.2**

Source: Canadian Grain Commission (1997c), "Quality of Western Canadian Malting Barley 1997".

* includes B1602, Excel, Robust and Stander

Table 3- 5 **Tested and Registered Malting Barley Varieties for Western Canada, Year 1998**

Two-row Cultivars	Registered Year	Six-row Cultivars	Registered Year
Harrington	1981	Bonanza	1970
Stein	1987	Argyle	1981
Manley	1990	B1602*	1989
AC Oxbow	1990	Duel	1990
B1215	1990	Tankard	1990
TR145	1997	Foster*	1997
TR243	1997	CDC Sisler	1995
TR229	1997	BT435*	1996
Merit	1998	Stander*	1996
TR118	1991		
TR119	1994		
AC Metcalfe	1994		
CDC Stratus	1994		
CDC Lager	1995		
TR133	1995		
TR139	1995		

Source: AAFRD (1999c), "Malting Barley Varieties".
web site -http://www.agric.gov.ab.ca/crops/barley/var04.html
Date accessed: 20 October 1999
* White aleuroned variety

Table 3- 6 **Tested and Registered Feed Barley Varieties for Western Canada, Year 1998**

Two-row Cultivars	Registered Year	Six-row Cultivars	Registered Year
Abee	1982	AC Albright	1992
Bridge	1990	AC Harper	1996
CDC Dolly	1994	AC Lacombe	1991
CDC Fleet	1996	AC Rosser	1996
Propect	1991	AC Stacey	1998
Seebe	1992	Brier	1988
Winthrop	1989	Bronco	1993
		Heartland	1984
		Jackson	1984
		Johnston	1980
		Leduc	1983
		Virden	1987

Source: AAFRD (1999d), "Feed Barley Varieties".
web site - http://www.agric.gov.ab.ca/crops/barley/var01.html
Date accessed: 20 October 1999

Table 3- 7 Total Barley Exports by Port of Clearance (in thousand tonnes), Years 1989-98

Crop-Year	Vancouver	Prince Rupert	Bay,Lakes & St.Lawrence	Atlantic Board	Churchill	Thunder Bay	Prairie	Total
1988/89	1,576.9	729.4	94.4	0.0	0.0	183.8	33.0	2,617.5
1989/90	1,754.3	1,926.2	50.5	0.0	270.5	207.7	20.7	4,229.9
1990/91	1,994.5	1,845.8	214.1	0.0	33.0	115.5	333.5	4,536.4
1991/92	1,695.0	1,067.7	0.0	0.0	32.2	55.2	490.6	3,340.7
1992/93	1,115.7	1337.0	28.1	0.0	31.4	31.9	159.5	2,703.6
1993/94	9,76.8	1124.0	1.2	0.0	0.0	388.3	1,281.8	3,772.1
1994/95	1,084.6	803.6	11.9	0.0	0.0	511.3	597.9	3,009.3
1995/96	1,044.6	481.7	24.3	0.0	0.0	430.7	354.5	2,335.8
1996/97	1,244.0	905.3	325.5	0.0	0.0	401.4	564.7	3,440.9
1997/98	1,020.6	392.0	7.6	0.0	0.0	318.0	387.6	2,125.8
Average	**1,350.7**	**1,061.3**	**75.8**	**--**	**36.71**	**264.4**	**422.4**	**3,211.2**

Source: Canadian Grain Commission (1998), "Canadian Grain Exports".

Table 3- 8 Canadian Barley Exports by Type - Malting Barley/Feed Barley, Year 1997/98

Destination	Malting Barley	Feed Barley	Total
Africa			
Tunisia		14,635	14,635
Asia			
China P.R.	561,722		561,722
Emirates U.A.		30,489	30,489
Iran		105,845	105,845
Japan	49,088	204,991	254,079
South Korea		18,700	18,700
Saudi Arabia		387,081	387,081
Total	**610,810**	**761,741**	**1,372,551**
W. Hemisphere			
Argentina	6,000		6,000
Chili	7,800		7,800
Mexico	54,153		54,153
USA	597,607	87,758	685,365
Total	**665,560**	**87,758**	**753,319**
Grand Total Exported	**1,276,371**	**849,499**	**2,125,870**

Source: Canadian Grain Commission (1998), "Canadian Grain Exports".

Table 3- 9 Canadian Barley Exports to Specific Countries by Clearance Sector, Year 1997/98

Destination	Pacific	Thunder Bay	Eastern	Prairies	Total
Africa					
Tunisia		14,635			14,635
Asia					
China P.R.	561,722				561,722
Emirates U.A.	30,489				30,489
Iran	105,769		76		105,845
Japan	254,058			21	254,079
South Korea	18,700				18,700
Saudi Arabia	379,496		7,584		387,080
Total	**1,350,235**	**14,635**	**7,660**	**21**	**1,372,551**
W. Hemisphere					
Argentina		6,000			6,000
Chili	7,800				7,800
Mexico	24,106	18,809		11,238	54,153
USA	30,481	278,548		376,337	685,366
Total	**62,387**	**303,357**		**387,575**	**753,319**
Grand Total Exported	**1,412,621**	**317,992**	**7,660**	**387,596**	**2,125,870**

Source: Canadian Grain Commission (1998), "Canadian Grain Exports".

Table 3- 10 Export Market Share of Barley World Market for Selected Countries, Years 1989-98

Year	Australia	Canada	E.U	U.S.	Others	Total
1988/89	8.60%	16.51%	52.66%	10.84%	11.40%	100.00%
1989/90	13.82%	23.89%	44.65%	10.16%	7.47%	100.00%
1990/91	13.54%	22.89%	35.60%	7.61%	20.36%	100.00%
1991/92	10.26%	17.57%	43.67%	10.99%	17.52%	100.00%
1992/93	15.57%	16.20%	30.83%	9.65%	27.75%	100.00%
1993/94	22.83%	20.69%	33.69%	8.38%	14.42%	100.00%
1994/95	8.72%	19.35%	32.54%	8.71%	30.68%	100.00%
1995/96	25.52%	17.66%	18.75%	8.93%	29.13%	100.00%
1996/97	23.23%	19.87%	35.73%	7.01%	14.16%	100.00%
1997/98	21.64%	16.26%	24.46%	8.15%	29.49%	100.00%
Average	**16.37%**	**19.09%**	**35.26%**	**9.04%**	**20.24%**	**100.00%**

Source: Canadian Wheat Board (1998) Annual Report, 1997-98.

Table 3- 11 **Barley, Census Data for 1986 and 1996, Canada**

Barley	1986	1996	% change 1986-96
Area in Acres	12,486,511	12,951,236	3.7%
No. of Farms Reporting	97,037	76,900	-20.8%
Average Area in Acres per Farm Reporting	129	168	30.9%

Source: Statistics Canada (1996b), "Historical Overview of Canadian Agriculture, Canada and Province" Catalogue No. 93-358-XPB.

Table 3- 12 **Barley: Farms Reporting and Area in Acres by Size Class, Census Data for 1976, 1986 and 1996, Canada**

	No. of Farms Reporting			% Distribution		
Size Class	**1976**	**1986**	**1996**	**1976**	**1986**	**1996**
1 to 32	24,611	22,887	13,837	24.7%	23.6%	18.0%
33 to 72	27,495	23,725	15,352	27.6%	24.4%	20.0%
73 to 127	21,682	19,746	15,483	21.8%	20.3%	20.1%
128 to 192	11,605	12,583	11,691	11.7%	13.0%	15.2%
193 to 447	11,480	14,168	15,244	11.5%	14.6%	19.8%
448 to 947	2,195	3,200	4,184	2.2%	3.3%	5.4%
948 to 1797	401	535	791	0.4%	0.6%	1.0%
1798 to 2397	66	113	169	0.1%	0.1%	0.2%
2398 and over	47	80	149	0.0%	0.1%	0.2%
Total	**99,582**	**97,037**	**76,900**	**100%**	**100%**	**100%**

Source: Statistics Canada (1996b), "Historical Overview of Canadian Agriculture, Canada and Province" Catalogue No. 93-358-XPB.

Table 3- 13 **Cattle and Calves, Census Data for 1986 and 1996, Canada**

Cattle and Calves	1986	1996	% change 1986-96
No. of Cattle and Calves	11,997,608	14,893,034	24.1%
No. of Farms Reporting	155,945	142,157	-8.8%
Average Number per Farm Reporting	77	105	-3.4%

Source: Statistics Canada (1996b), "Historical Overview of Canadian Agriculture, Canada and Province" Catalogue No. 93-358-XPB.

Table 3- 14 **Pigs, Census Data for 1986 and 1996, Canada**

Pigs	1986	1996	% change 1986-96
No. of Pigs	9,756,569	11,040,462	13.2%
No. of Farms Reporting	36,472	21,105	-42.1%
Average Number per Farm Reporting	268	523	-38.7%

Source: Statistics Canada (1996b), "Historical Overview of Canadian Agriculture, Canada and Province" Catalogue No. 93-358-XPB.

Table 3- 15 **Hen and Chickens, Census Data for 1986 and 1996, Canada**

Hens and Chickens	1986	1996	% change 1986-96
No. of Hens and Chickens	87,942,244	102,255,149	16.3%
No. of Farms Reporting	56,466	28,240	-50.0%
Average Number per Farm Reporting	1,557	3,621	-47.0%

Source: Statistics Canada (1996b), "Historical Overview of Canadian Agriculture, Canada and Province" Catalogue No. 93-358-XPB.

Table 3- 16 **Cattle and Calves: Farms Reporting and Number of Animals by Size Class, Census Data for 1976, 1986 and 1996, Canada**

	No. of Farms Reporting			% Distribution		
Size Class	**1976**	**1986**	**1996**	**1976**	**1986**	**1996**
1 to 32	90,428	58,078	43,027	40.1%	37.2%	30.3%
33 to 77	76,538	50,161	42,983	34.0%	32.2%	30.2%
78 to 122	30,762	23,648	23,924	13.7%	15.2%	16.8%
123 to 177	13,559	11,305	13,284	6.0%	7.2%	9.3%
178 to 272	8,032	7,154	9,966	3.6%	4.6%	7.0%
273 to 527	4,503	4,120	6,495	2.0%	2.6%	4.6%
528 to 1127	1,143	1,178	1,850	0.5%	0.8%	1.3%
1128 and over	288	301	628	0.1%	0.2%	0.4%
Total	**225,253**	**155,945**	**142,157**	**100%**	**100%**	**100%**

Source: Statistics Canada (1996b), "Historical Overview of Canadian Agriculture, Canada and Province" Catalogue No. 93-358-XPB.

Table 3- 17 **Pigs: Farms Reporting and Number of Animals by Size Class, Census Data for 1976, 1986 and 1996, Canada**

	No. of Farms Reporting			% Distribution		
Size Class	**1976**	**1986**	**1996**	**1976**	**1986**	**1996**
1 to 77	49,123	20,091	9,795	77.2%	55.1%	46.4%
78 to 272	9,362	7,408	3,509	14.7%	20.3%	16.6%
273 to 527	3,026	3,813	2,553	4.8%	10.5%	12.1%
528 to 1127	1,476	3,237	2,644	2.3%	8.9%	12.5%
1128 to 2652	501	1,525	1,839	0.8%	4.2%	8.7%
2653 to 4684	81	297	456	0.1%	0.8%	2.2%
4685 and over	33	101	309	0.1%	0.3%	1.5%
Total	**63,602**	**36,472**	**21,105**	**100%**	**100%**	**100%**

Source: Statistics Canada (1996b), "Historical Overview of Canadian Agriculture, Canada and Province" Catalogue No. 93-358-XPB.

Table 3- 18 **Laying Hens: Farms Reporting and Number of Animals by Size Class, Census Data for 1976, 1986 and 1996, Canada**

	No. of Farms Reporting			% Distribution		
Size Class	**1976**	**1986**	**1996**	**1976**	**1986**	**1996**
1 to 122	71,476	34,348	18,515	92.0%	86.8%	84.9%
123 to 972	3,958	3,289	1,707	5.1%	8.3%	7.8%
973 to 9977	1,615	1,295	915	2.1%	3.3%	4.2%
9978 to 20022	448	452	439	0.6%	1.1%	2.0%
20023 to 45132	144	155	176	0.2%	0.4%	0.8%
45133 and over	39	46	59	0.1%	0.1%	0.3%
Total	**77,680**	**39,585**	**21,811**	**100%**	**100%**	**100%**

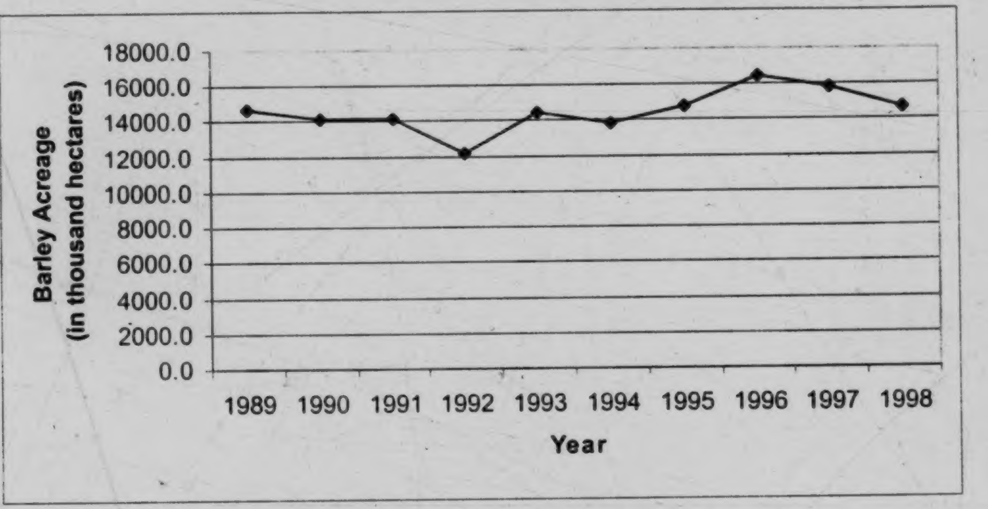
Source: Statistics Canada (1996b). "Historical Overview of Canadian Agriculture, Canada and Province" Catalogue No. 93-358-XPB.

Table 3- 19 **Canadian Livestock and Poultry Feed Use for Years 1993/94 - 1997/98 (in thousands of tonnes)**

Feed	**1993/94**	**1994/95**	**1995/96**	**1996/97f**	**1997/98f**
Wheat	5,587	4,030	4,184	4,238	4,019
Corn	5,739	6,135	5,918	6,244	6,295
Barley	7,906	9,006	9,382	9,149	9,569
Other Coarse Grains	2,598	2,855	2,389	2,693	2,465
Sub-total	**21,830**	**22,026**	**21,873**	**22,324**	**22,348**
Soy-meal	1,530	1,682	1,634	1,742	1,900
Canola-meal	405	488	601	524	600
Peas	140	200	240	250	260
Other Feed Products	444	438	427	422	422
Sub-total	**2,519**	**2,808**	**2,902**	**2,938**	**3,182**
Total Feed	**24,349**	**24,834**	**24,775**	**25,262**	**25,530**

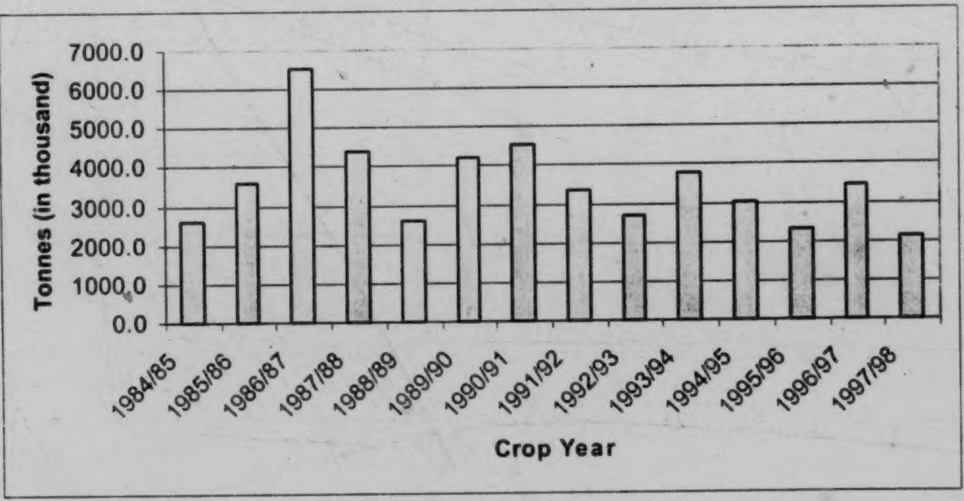
Source: Agriculture and Agri-Food Canada (1997), "The Canadian Feed Industry".
f: forecast

Figure 3- 1 : **Trend of Total Barley Acreage Canada, Years 1989-98**



Source: Statistics Canada (1998), "Field Crop Report Series".

Figure 3- 2 **Total Canadian Barley Exports, Years 1984/85 - 1997/98**



Source: Canadian Grain Commission (1998),"Canadian Grain Exports".

CHAPTER FOUR: Statistical Methodologies

4.1 Overview of Methods Used in SCM Studies

Most SCM studies are case studies, documentation of SCM experience or identification of transaction costs that could be eliminated through SCM (Hobbs and Young 1999; Martinez 1999; Martinez et al. 1997; Boehlje et al.1998; Kennett 1997a, 1997b, 1997c). Empirical study on SCM is limited because transaction costs, by their nature, are difficult to measure (Hobbs 1997). They must first be identified and defined. An appropriate measurement is not easy to obtain and the information on transaction costs is usually not publicly available. This requires the collection of primary data and the construction of proxy variables (Hobbs 1997). The former can be time-consuming and expensive.

An empirical study in cattle marketing by Hobbs (1997) estimates the importance of transaction costs in the choice of marketing channel. A survey was done to obtain information on how much time is spent to discover the auction price, the direct sale price, the cost of transporting beef stock to auction, to packer, etc. The information was used to measure the transaction costs in three categories, namely, information costs (the cost of price discovery and price uncertainty), negotiation costs and monitoring costs. Hobbs (1997) used a two-limit Tobit model to analyze the data. The dependent variable of the regression is the proportion of cattle sold through auctions. The independent variables are vectors of independent transaction costs and producer characteristics such as herd size, production methods, number of workers, type of cattle, etc. The results provided information on whether the liveweight marketing channel impose significant information costs, negotiation costs and monitoring costs on producers. In conclusion, Hobbs (1997) suggests that the cattle sold through auction incurs significant negotiation and monitoring costs, which may explain why over 50% of the respondents sold their cattle through cooperative marketing groups.

There are recent VC/SCM studies such as Kennett's study (1997) on the wheat supply chain and Hobbs and Young's study (1999) on the use of contracting in the US and Canadian grains industry. Both studies use case studies to show evidence of increasing VC in agri-food supply chain.

Overall, the study of SCM requires the collection of primary data. This is accomplished either by survey methods or by using a case study approach. A survey of the feed mill market is used in this study. The previous chapter identified the potential SCM drivers for the feed barley market. The potential SCM drivers are likely the result of recent changes in technology and the regulatory environment. The impact of these changes is going to be reflected in the demand of feed barley, such as:

1. buyers' preferences for long term contracts to maintain consistency in supply;
2. buyers' preferences for contracting a particular type of barley for specific rations;
3. buyers' preferences for a long term buy/sell relationship that emphasizes high traceability of agronomic practices for growing barley.

An empirical test for these buyers' preferences in the demand of feed barley will indicate whether there is potential for applying SCM between the barley and livestock industries. The remaining sections of this chapter give an account of selected statistical methodologies for the analysis of preferences.

4.2 The Scaling Method

A scaling approach can be used to develop profiles for product attributes and buyers' attitudes. The respondents are asked to reveal their preferences for product attributes on a 7-point scale of 1 = Not Important and 7 = Very Important. The average rankings provide information on the preferred product attributes and dominant buyer behavior. Capps et al. (1988) used the scaling method to examine the attitude of consumers toward low fat foods. Kim et al. (1996) used the scaling method to evaluate

Korean beef buyer perception on product quality, promotional activity and country image of Canada, US and Australia. Unterschultz et al. (1996) used the scaling method to analyze consumer attitudes to fresh meat and biopreservatives. This study employs the scaling method to evaluate whether there are buyer preferences for specific product attributes and business relationships.

4.3 The Factor Analysis Method

Factor analysis can be used to summarize the "important information" in the scaling data into fewer number of factors (Churchill 1987). The analysis enables researchers to explain the observed rankings in terms of unobserved factors. These unobserved factors should be associated with the most important general criteria used by respondents to generate the observed rankings. Factor analysis is expected to produce factors that explain most of the variation in the original variables. Factor analysis also enables an examination of whether some attributes could be eliminated in future surveys (Kim et al. 1997).

Factor analysis generates a factor loading for each variable. The sign of the factor loading provides information on the interrelationship between variables. For instance, Kim et al. (1997) used factor analysis to analyze the Korean buyers' preferences of beef imports from Canada, Australia and the US. The factor analysis was conducted on the scaling data to evaluate the importance of the beef attributes and consistency of answers between respondents for the three different countries. Kim et al. (1997) found that the Korean beef buyers rated the product attributes consistently on questions related to country images or promotional activities, but less consistently on questions related to product quality.

This study employs factor analysis to examine the importance of the product attributes and the relationships between product attributes. Factor analysis can also be used to explore the feed mills' perception of barley attributes and business relationships with barley suppliers. Factor analysis is employed on the scaling data.

4.3.1 The Analytical Framework of Factor Analysis Model

The factor analysis model is generally expressed as (Jobson 1991):

$$X = FA' + U \qquad (1)$$

where X = observed data (n x p) matrix of p observed variables $X_1, X_2, \ldots, X_p$ for the n observations and $X \sim N(\mu, \Sigma)$

F = unobserved (n x r) matrix of values of r (where $r < p$) linearly independent common factors $F_1, F_2, \ldots, F_r$ for the n observations and it is assumed that $F \sim N(0, I)$

A'= unknown factor pattern or loading (r x p) matrix; and

U = (n x p) matrix of unobserved errors or values of unique factors (i.e. U_i is unique to X_i), which are mutually uncorrelated, for the n observations and $U \sim N(0, \sigma_u^2 I)$

Assuming all of the common factors are uncorrelated with the unique factors and are independent to each other, the X covariance matrix Σ can be expressed as (Jobson 1991):

$$\Sigma = AA' + \Psi \qquad (2)$$

where $\Psi = \sigma_u^2 I$

Unlike a multiple linear regression model, the entire right-hand side of the model is unobserved. Nevertheless, the matrix F can be estimated using principal component analysis. The matrix X can be written as $X = (Z\Lambda^{-1/2})(\Lambda^{1/2} V')$, where $Z\Lambda^{-1/2}$ have unit variances. The estimated F and A' can be expressed as (Jobson 1991):

$$F = Z\Lambda^{-1/2} \text{ and } A' = \Lambda^{1/2} V' \qquad (3)$$

where Λ= the diagonal matrix of r eigenvalues λ_k and $k = 1,2,\ldots, r$

$Z = X V$, a $(n \times r)$ matrix consists of principal components $Z_1, Z_2, \ldots, Z_r$ and the principal component is a linear combination of the p X variables, e.g. $Z_1 = v_{11}X_1 + v_{21}X_2 + \ldots + v_{p1}X_p$.

$V = (p \times r)$ matrix whose columns are the first r eigenvectors of $X'X$ and the eigenvectors are mutually orthogonal.

Since the magnitude of the eigenvector v_j is arbitrary, $v_j'v_j = 1$ is imposed such that the eigenvalues λ_j where $j = 1,2,\ldots,r$, and the corresponding eigenvectors v_j where $j = 1,2,\ldots,r$ and the number of solutions r corresponds to the rank of $X'X$.

The first principal component Z_1 is the combination that accounts for or explains the largest amount of variance in the sample. The second principal component Z_2 accounts for the next largest amount of variance and is uncorrelated with the first. Successive components explain progressively smaller portions of the total sample variance, and all components are uncorrelated with each other. These are used to estimate the model factors.

The factor analysis model is estimated using principal component analysis, a technique to transform a set of correlated variables to a set of uncorrelated variables (principal components). A factor loading is estimated for each of the factors. The sign of the factor loading provides information of the interrelationship between the product attributes.

For example, a three-factor model is expressed as:

$$X = \alpha_1 F_1 + \alpha_2 F_2 + \alpha_3 F_3 + U$$

The coefficients, α_1, α_2 and α_3 indicate how much weight is assigned to each of the factors, F_1, F_2 and F_3. Factors with large coefficients (in absolute value) for a variable are closely related to the variable and help explain the observed variable X. Since the factors generated by principal component analysis are uncorrelated, the values of the coefficients are not dependent on each other. They represent the unique contribution of each factor to the observed response and are the correlations between the factors and the variable. The eigenvalue criteria equal to 1 (Jobson 1991) can be used to determine the number of factors. As well varimax rotation can be used as a means to obtain factors that are more easily interpretable (Jobson 1991). Varimax rotation exhibits loadings that are high on the same single factor, moderate to low on a very few factors and negligible on the remaining factors.

4.4 The Stated Preference Analysis Method

The stated preference model (SPM) can be used to evaluate consumer preferences on selected product attributes. It has been used to assess the potential for new consumer markets, to understand future demands and to give directions to marketing strategies. For instance, Unterschultz et al. (1998) used SPM to assess the potential for the Canadian beef industry to penetrate the South Korean market. Dunlevy (1998) used SPM to compare the attributes of Alberta potatoes to those of other regions in the British Columbia table potato market. Moreover, SPM can be used to assess the potential of marketing a new product, or a new feature of an existing product. For instance, Unterschultz et al. (1996) used SPM to analyze the potential use of biopreservatives in fresh meat packages. Kuperis et al. (1998) used SPM to analyze the consumer response to the potential use of bovine somatotrophin in Canadian dairy production.

In many cases the products being examined are not available or used in the market. The benefit or the utility of the purchase cannot be evaluated by observing whether the purchase is made or not. Hence, the researchers develop a profile of descriptions about the product in terms of product attributes/factors and randomly selected the level for each factor to form hypothetical choices. The respondents are asked to make choices between different product profiles. Inference can be made about the buyers' preferences based on the comparison of the observed choices to the rejected alternatives. This method is relatively easy to control because it allows explicit definition of the conditions or factors, which are being evaluated by the respondents. It is also flexible enough to examine alternatives that cover key variables of interest. It is relatively cheap to apply.

In the recent empirical research literature, SPMs have been used extensively as the primary research methodology in marketing and evaluating environmental amenities (Adamowicz et al. 1992; Loviere 1988; McFadden 1986). Stated preference uses discrete choice models. Discrete choice models are one application of Random Utility Theory (McFadden 1974). Further details on the theory and logic behind discrete choice experiments are found in Louviere (1981), Louviere and Hensher (1982), and Louviere and Woodworth (1983). In stated preference studies, respondents do not make behavioral changes. They simply state what they would do. Studies (Louviere 1994; Adamowicz et al.1992) on stated preference modelling suggest that stated preference models appear to reflect the actions taken by respondents.

This study employs SPM to evaluate whether feed mill barley buyers prefer product attributes that increase the potential for SCM, such as preferring a product that comes with a detailed feed analysis or that can be traced back to all agronomic practices. SPM allows the researchers to test if there are buyers' preferences on product attributes. The analytical framework of SPM is presented next.

4.4.1 The Analytical Framework of SPM

The SPM is generally specified in the framework of a random utility function defined in terms of product attributes (Adamowiz et al. 1992), which is expressed as

$$U_{in} = V(X_{in}) + \varepsilon\,(X_{in}) \qquad (4)$$

where U_{in} = consumer n's utility of choosing alternative product i

V = the indirect utility function associated with the alternative

X_{in} = a vector of attribute values for alternative i as viewed by respondent n

ε = a random element associated with error in measurements of utility

The utility function, U_{in}, consists of an observable term V and the unobservable term ε, which is assumed to be independently, identically, and Gumbel-distributed with mean equal to one. The choice probability of alternative product i is equal to the probability that the utility of alternative product i (U_{in}) is greater than or equal to the utilities of all other alternatives in the choice set. This can be expressed as:

$$\pi_n(i) = \text{Prob}\,[V_{in} + \varepsilon_{in} \geq V_{jn} + \varepsilon_{jn}\,;\ \text{all}\ j \in C_n] \qquad (5)$$

where C_n is the choice set for respondent n.

Assuming that all the disturbances, ε_{in}, are independently, identically, and Gumbel-distributed with a scale parameter $\mu > 0$, then the probability of choosing an alternative is expressed as:

$$\pi_n(i) = \exp\,[\mu V_{in}] \,/\, \sum_{j} \exp\,[\mu V_{jn}] \qquad (6)$$

Assuming the V_{in} is linear-in-parameters, the functional form can be expressed as:

$$V_{in} = \beta_1 + \beta_2 X_{in2} + \ldots + \beta_k X_{ink} \qquad (7)$$

where, V_{in} = respondent n's indirect utility of choosing alternative i

X_{ink} = kth attribute values for alternative i as viewed by respondent n

β_1, β_2 to β_k are coefficients to be estimated.

If a single vector of coefficients β that applies to all the utility functions is defined, and the scale parameter $\mu = 1$, then equation (5) can be expressed as a multinomial logit model:

$$\pi_n(i) = \exp\,[\beta' X_{in}] \,/\, \sum_{j} \exp\,[\beta' X_{jn}] \qquad (8)$$

where $\pi_n(i)$ = respondent n's choice probability of alternative i,

X_{in} and X_{jn} = vectors describing the attributes of alternative i and j, and

β = vector of coefficients.

The coefficients measure the importance of the attributes to the probability of choosing a particular product. Using results from the model, individual attributes can be measured.

CHAPTER FIVE: Survey Methdologies

5.1 Introduction

The previous chapters identified motivations driving SCM. One of the conditions that can greatly increase the potential for SCM is a high degree of product specificity. If the important product attributes of feed barley are not readily identifiable, there will be potential for SCM to ensure delivery of desirable product attributes. Therefore, testing the importance of non-visible barley quality attributes such as protein, amino acid and starch in purchasing decisions will provide information on the potential for SCM. In addition, if product quality control is increasingly important from the feed barley buyers' perspectives and factors such as the trace-back to farmers' agronomic practices as well as the preferences for dealing with known suppliers are important concerns in purchasing decisions, the potential for SCM will also increase. A survey questionnaire was set up to investigate how important are the non-readily identifiable product attributes in the feed barley purchasing decisions and whether there are preferences for trace back and long term contracting. The survey was conducted on feed mills in Alberta. Feed mills are key players in the feed market. They buy barley from farms and sell prepared livestock feeds to livestock farms. The remaining sections on this chapter describe the survey development and research methodology.

5.2 Survey Development

This section explains general specifications regarding choices of study area, variables and survey method. The study area is chosen in Alberta because Alberta maintains the largest barley acreage in Canada, which gives good representation to the barley supply chain. The survey is conducted on the feed mill industry, which is one of the major players in the barley supply chain and may possess marketing information of their customers, the livestock producers, such as what barley attributes are valued by the livestock and poultry industries.

5.2.1 Study Area and Target Participants

The survey was conducted in Alberta in November 1999. Since Alberta is a major grower of barley as well as a major livestock producer in Canada, the study should ideally give representation to the agricultural supply chain between these two industries. This study focuses on feed mill companies, which includes companies that clean and process grains and other components into feed for livestock and poultry. Many of them send barley samples to laboratories for quality and some employ nutritionists to design and evaluate the feed formula of their products (Interview 1999). These companies are the agents, who supply quality feeds for the livestock industry. They possess information about the users' preferences for animal feeds and are presumed to be sensitive to feed quality.

The list of feed mill companies was obtained on the web site of the Alberta Agriculture Food and Rural Development (http://www.agric.gov.ab.ca/food/process/ fdprcdir /feeds.html. Date accessed: October 10, 1999) and cross checked with the commercial listings on companies under feed industry, which are available on the web site of Telus and the publication of the Scott's Western 1999. All of the listed feed mills, which include all major feed mills in Alberta, were contacted. Out of a total of twenty-eight contacts, one was not interested to participate, ten agreed to do the survey through direct interviews and seventeen agreed to do the survey through the mail.

5.2.2 Product Characteristics and Attributes

To select appropriate barley attributes for testing, two sources are referenced: 1) a typical purchasing specification (Table 5-1) from the article "Feed Industry Standards for

Barley" by Arnold Pierce of Unifeed (1998); and 2) a typical physical and chemical compositional analyses (Table 5-2) from the article "A Dairy Cow Perspective on Barley Grain Quality" by Khorasani et al. (1998). The barley attributes examined in these studies are under consideration because first, the purchasing specification (Table 5-1) contains the criteria for the physical characteristics of barley, which are typically used by feed manufacturers and grain buyers (Pierce 1998). Second, the results of the physical and chemical compositional analyses (Table 5-2) give a mean taken from 60 barley cultivars and those barley characteristics are typically measured in the study of barley grain quality (Khorasani et al. 1998). Amino acids are important to nutritionists when formulating diets for monogastric animals (Jaikaran et al. 1998). Specifically, lysine and threonine content is considered one of the primary nutritive values of barley for pigs (Huang et al. 1998). Eight barley attributes are considered important either from the viewpoint of buying specification in the feed industry or from the viewpoint of research studies on barley quality, and these are:

	Minimum Level	Maximum Level
1) Protein level	12.5%	--
2) Starch level	55%	--
3) Lysine content	3.25%	--
4) Threonine content	3.25%	--
5) Moisture level	--	14.8%
6) Foreign material	--	3.5%
7) Bushel weight	48 pounds per bushel	--
8) Uniform kernels	--	--

Protein, starch, lysine and threonine content are important quality characteristics that cannot be readily identifiable at the point of delivery. If these attributes are important in buying decisions, there is the potential for SCM to reduce the cost of searching or testing for these attributes. The other four attributes, moisture level, foreign material, bushel weight and uniform kernels are physical characteristics that are common in a buyer's checklist to measure barley quality at the time of purchase. If the physical characteristics dominate buying decisions, it indicates a lesser need for SCM or other forms of VC.

In addition to these physical and quality characteristics of barley, selected barley seller characteristics are of interest to SCM studies. As discussed in Chapter 3, potential SCM drivers are motivations to reduce the risk of uncertainties about price, quality or supply. Therefore, a supplier:

1) from whom the respondent has purchased barley before;
2) who is willing to guarantee barley quality;
3) who is willing to negotiate on prices of feed barley;
4) who is willing to enter a long-term barley supply contract; and
5) who is willing to provide detailed production information on the barley variety, fields grown as well as all agronomic practices, can be viewed as attributes adding value to the product.

A strong preference for any of these seller characteristics indicates a higher potential for SCM. Finally, the variety of barley is also specified as one of the attributes to see if any significant preference indicates that buyers are looking for specific cost-saving or value-enhancing barley varieties for feed. A strong preference for specific varieties may indicate a higher potential for SCM. All of the above selected product attributes and characteristics of barley are tested using the factor analysis and the stated preference techniques.

For the factor analysis model, all eight physical and quality characteristics as well as the first four seller characteristics identified above are included. The variable, "overall barley quality", which has been described as the levels of crude protein, amino acids, starch content etc., is also included to cross check the consistency of buyer's preference for information on barley quality characteristics (Appendix I).

For the stated preference model, six attributes are chosen to make up the profile of the barley in each alternative. They are specified as Weight, Detailed Feed Analysis, Known Supplier, Variety, Trace Back and Price. First of all, bushel weight, which is one of the important physical attributes of barley used in the buying criteria, is selected as a variable to see whether it has a dominant impact in barley buying decisions. Second, the detailed feed analysis is described as a document certified that the barley meets the minimum criteria of 12.5% crude protein and 55% starch content. It also contains the details about amino acid such as lysine and threonine, expressed in percentage of crude protein. This variable is designed to incorporate all the selected quality characteristics, which can give an indication of how important are the non-readily identifiable product attributes in the purchasing decisions. Third, two seller characteristics are selected. They are: 1) Known Supplier, which is described as a supplier, from whom the respondent has purchased barley before; and 2) Trace Back, which is described as a supplier who can provide information of the barley variety, fields grown and all agronomic practices. These two variables serve to give an indication of the motive to reduce the risk of uncertainties about quality. Fourth, the variety of barley is selected as a variable to see if there is any motivation for targeting a particular barley variety for feed. Finally, price is selected as a variable to see if it has a dominant impact over quality or seller characteristics in barley buying decisions.

Each of these factors/attributes for the stated preference questions and the respective levels are presented in Table 5-3. The levels for the bushel weight are referenced from the study results of the 60 barley cultivars by Khorasani et al. (1998) and adjusted slightly after the pretest of the survey. The price levels are referenced (one week prior to the survey) from the prevailing price of barley across different areas in Alberta reported on the web site of the Alberta Grain Commission.

5.2.3 The Questionnaire

The questionnaire (a sample is found in Appendix I) consists of three parts. The first section contains thirteen questions requesting the respondents to assess the importance of the product attributes/characteristics of barley using a rating of a 7-point scale of 1 = Not Important and 7 = Very Important. Respondents indicate which rating best described their perception of the importance of product attributes/characteristics in their purchasing decisions. Only one choice from the ratings is to be made for each question.

The second section contains eight scenarios of stated preference questions. Each scenario consists of three alternatives, which provide different descriptions of the product. Alternative A and B contain different profiles of the product relating to the factors. It is assumed that the descriptions of the factors will affect the buyer's perceptions of the product and ultimately translate into a decision to purchase or not to purchase the specified products. The inclusion of a non-choice, alternative C, which is to be chosen if neither description of the product in alternative A and B are preferred. The product profiles of alternatives A and B were generated by a fractional factorial experiment, which was designed involving all possible combinations of the factor levels. The design produced a sample of 32 treatments selected from the complete factorial design. To avoid a lengthy questionnaire, the 32 treatments were blocked into four groups to produce eight scenarios per questionnaire.

The third section contains eleven questions. Some of the questions are related to demographic factors such as the percentage of feed sold to each of the livestock and poultry markets and the quantity of barley purchased annually. There are questions asking respondents to reveal whether they test their barley for quality and whether they prefer a particular variety of barley or hulless barley for feed. There are also questions asking the respondents' opinion about what are the important quality characteristics in barley, how effective is the current grading system of barley used by Canadian Grain Commission (CGC) in providing the information for selecting the suitable barley for feed and whether they prefer to have long term supply contracts for barley. Most of the information provided by the third section is used for segmenting the data for stated preference analysis.

The questionnaire was pretested once. The respondent was the feed plant manager of a feed mill. The feed mill marketed most of its feed to the poultry industry and purchased about 5000 tonnes of barley a year. It regularly sends barley samples for testing to its laboratory. The company's nutritionist uses the testing results to formulate the feed. The respondent agreed that the questions in the survey were well-understood and easy to answer. Suggestions were given on setting the appropriate levels of bushel weight and adding moisture level as an important characteristic for evaluation. The questionnaire was adjusted accordingly. No further pretest was taken to avoid losing data points because the sample size is relatively small.

5.2.4 Survey Method

A total of twenty-eight feed mills were contacted by phone. One was not interested in participating, ten agreed to do the survey through direct interviews and seventeen agreed to do the survey through the mail. Some feed mills belong to the same company but are located in different areas. The target contact persons were feed plant managers or managers who are directly involved in barley purchase decisions.

Each of the direct interviews was a structured interview. The respondent was asked to complete the survey questionnaire and then was consulted on the following questions:

1. Is there any factor that you think is important in the barley buying decision but has not been included in this survey?
2. Do you see any key changes happening in the feed industry now / in the future?
3. Do you think that the feed processing market is highly concentrated?
4. Do you think that your company differentiates itself by product quality or by location?

In addition, respondents were encouraged to express their opinions about the survey questions and explain briefly what factors dominate their considerations when making the choices of rating and alternatives. Opinions about the quality of barley, the key changes in the feed industry and their experiences about long-term contracting were documented. The direct interviews were arranged with feed mills located between Edmonton and Calgary. These interview responses reflect buyer preferences in the central areas of Alberta and are compared with responses from other areas of the province.

A copy of the survey questionnaire with a pre-stamped return envelope was sent to each company, which agreed to do the survey by mail. To encourage a high response rate, a follow-up contact through telephone with respondents, who had not returned their completed questionnaire, were given after 18 days from the initial mailing. Eventually, 15 out of 17 mailed questionnaires were returned. Together with the 10 questionnaires completed in the direct interviews, they represented a 93% response to the study.

5.3 Model Specifications for Stated Preference Model

This section provides the specification for SPMs. Equations are expressed in terms of variables for empirical testing. The theoretical specifications were described in chapter 4. In addition, descriptions are given on how to segment the survey data for analysis.

Information provided from the stated preference questions of the survey were used as the data to estimate a multinomial logit model, which assesses the impact on buyers choices of each specified factor/attribute. The model is non-nested, assuming there is only one level of decision-making in the barley purchase decision.

The method of effects coding is used to input the factor levels, so that the base alternative C will be exactly equal to the origin. One factor level of each attribute is omitted in the estimation procedure to avoid singularity. For any occurrence of the omitted variable, the included variables are coded –1 (Johnson et ai. 1987). The estimated coefficients on the attribute levels are to be interpreted as the effect of the attribute level on the probability of a product being purchased. Hence, a positive (negative) coefficient on a factor means that the factor has an effect of increasing (decreasing) the probability of a product being purchased.

Twelve models are set up for the stated preference analysis. Model I is a non-segmented model estimated to assess the overall buyer preferences of the feed mills in Alberta. The estimated results of Model I are expected to provide the information on:

(1) whether the feed mills in Alberta value the information of some non-readily identifiable quality characteristics of barley when making barley purchasing decision; and

(2) whether the feed mills in Alberta value some seller characteristics of barley when making barley purchasing decision.

The SPM non-segmented model (Model I) is expressed as:

$$V_i\,(A) = V_i\,(B) = V_i\,(C) = \sum_{k=1}^{4} \beta_{1ki}\, WT_i + \beta_{2i}\, DFA_i + \beta_{3i}\, KS_i + \beta_{4i}\, 2Rmalt_i + \beta_{5i}\, 6Rmalt_i$$

$$+ \beta_{6i}\, 2Rfeed_i + \beta_{7i}\, 6Rfeed_i + \beta_{8i}\, TB_i + \sum_{k=1}^{4} \beta_{9ki}\, Price_i + \varepsilon_i$$

where V_i = utililty of choosing alternatives barley profile i

WT_i = bushel weight for barley for profile i

DFA_i = detailed feed analysis for barley for profile i

KS_i = barley comes from a known supplier for profile i

$2Rmalt_i$ = barley of a 2-row malt variety for profile i

$6Rmalt_i$ = barley of a 6-row malt variety for profile i

$2Rfeed_i$ = barley of a 2-row feed variety for profile i

$6Rfeed_i$ = barley of a 6-row feed variety for profile i

TB_i = barley that can be traced back of its variety, field grown and all agronomic practices for profile i

$Price_i$ = price for barley for profile i

Model II is a segmented model estimated to test for differences between locations, central versus other areas in Alberta, and test for differences between interview and mail surveys. Model III is a segmented model estimated to compare responses from feed mills selling their feed mostly to beef and dairy (ruminant) markets with those selling their feed mostly to pork and poultry (monogastric) markets. Models IV to VII are segmented models estimated for feed mills selling their feed mostly to beef, dairy, pork and poultry market respectively. These models are estimated to test for differences between feedmills that have marketed most of their feed to a specific livestock industry.

Model VIII is a segmented model estimated to compare feed mills that have long-term contracts with farmers, with those feed mills that have not. Model IX is a segmented model estimated to compare feed mills that have higher volume of barley purchase, with those feed mills that have lower volume. Model X is a segmented model estimated to compare feed mills that prefer a particular type of barley, with those feed mills that do not. Model XI is a segmented model estimated to compare feed mills that consider the CGC grading system effective in providing information for selecting the suitable barley for feed, with those feed mills that do not. Model XII is a segmented model estimated to compare feed mills that purchase hulless barley for feed, with those feed mills that do not. A study by Jaikaran et al. (1998) shows that hulless barley has higher feeding value than hulled barley. Feedmills who use hulless barley in feed mixes may have stronger motivations to search for barley with higher feeding value.

The estimated results from the segmented Models II to XII are expected to show whether the segmented groups:

(1) value the information of some non-readily identifiable quality characteristics of barley when making barley purchasing decision; and

(2) value some seller characteristics of barley when making barley purchasing decision.

The SPM segmented model (for Model II to XII) is expressed as:

$$V_{it}\,(A) = V_{it}\,(B) = V_{it}\,(C) = \sum_{k=1}^{4} \beta_{1kit}\, WT_{i} + \beta_{2it}\, DFA_{it} + \beta_{3it}\, KS_{it} + \beta_{4it}\, 2Rmalt_{it} + \beta_{5it}\, 6Rmalt_{it}$$

$$+ \beta_{6it}\, 2Rfeed_{it} + \beta_{7it}\, 6Rfeed_{it} + \beta_{8it}\, TB_{it} + \sum_{k=1}^{4} \beta_{9it}\, Price_{it} + \varepsilon_{i}$$

where

V_{it} = utililty of choosing alternatives barley profile *i* of group *t*

WT_{it} = bushel weight for barley for profile *i* of group *t*

DFA_{it} = detailed feed analysis for barley for profile *i* of group *t*

KS_{it} = barley comes from a known supplier for profile *i* of group *t*

$2Rmalt_{it}$ = barley of a 2-row malt variety for profile *i* of group *t*

$6Rmalt_{it}$ = barley of a 6-row malt variety for profile *i* of group *t*

$2Rfeed_{it}$ = barley of a 2-row feed variety for profile *i* of group *t*

$6Rfeed_{it}$ = barley of a 6-row feed variety for profile *i* of group *t*

TB_{it} = barley that can be traced back of its variety, field grown and all agronomic practices for profile *i* of group *t*

$Price_{it}$ = price for barley for profile *i* of group *t*

t = segmented group (survey by directed interviews or mail-back for Model II)
" (ruminant or monogastric animals for Model III)
" (marketed most of the feed to beef industry or not for Model IV)
" (marketed most of the feed to dairy industry or not for Model V)
" (marketed most of the feed to pork industry or not for Model VI)
" (marketed most of the feed to poultry industry or not Model VII)
" (have long-term contract with farmers or not for Model VIII)
" (have high volume of barley purchase or not for Model IX)
" (prefer a particular type of barley or not for Model X)
" (consider the CGC grading system effective or not for Model XI)
" (purchased hulless barley for feed or not for Model XII)

Table 5- 1 Typical Purchasing Specification Used by Arnold Pierce of Unifeed (1998)

Criteria	(Covered Barley)	Hulless Barley
Test weight	min. 48lb/bushel	max. 56 lb/bushel
Moisture	max. 14.5%	max. 14.5%
Sound kernels	min. 85%	min. 90%
Adhering hulls (on Kernel)	--	max. 15%
Plumpness	min. 75% (over 6/64" sieve for rolling)	--
Foreign material	max. 3.5%(include other grains)	max. 3.0% (include other grains)
Wild oats	max. 1.0% (roll), max 2.0%(grind)	max. 1.0%
Ergot	max. 5 ergot bodies/litre	max. 5 ergot bodies/litre

Source: Pierce A B (1998). "Feed Industry Standards for Barley".

Table 5- 2 Results of the Physical and Chemical Compositional Analyses by Khorasani et al (1998)

	Mean	Minimum	Maximum
Starch,%	55.2	48.3	62.5
Crude Protein, %	13.3	10.8	16.2
Test Weight, kg/hl*	63.7	51.2	80.2
Kernel Weight	42.9	26.1	53.9

Source: Khorasani et al (1998). "A Dairy Cow Perspective on Barley Grain Quality".
*1 kg/hl = 0.77lb

Table 5- 3 Product Attributes/Factors and Levels

Product Attributes/Factors	Level 1	Level 2	Level 3	Level 4
Weight (pounds per bushel)	45	49	53	57
Detailed Feed Analysis	Yes	No	-	-
Known Supplier	Yes	No	-	-
Variety	2-row Malt	6-row Malt	2-row Feed	6-row Feed
Trace Back	Yes	No	-	-
Price (CdnS per tonne)	80	90	100	110

CHAPTER SIX: Results and Discussions

6.1 Introduction

A survey of buyer preferences in Alberta feed mill industry was conducted in November 1999. Twenty-five questionnaires were completed. The survey contains three sections. The first section consists of scaling questions for the calculation of average rankings to indicate how important are some selected physical, quality and seller characteristics of barley in purchasing decisions. The data are also used for factor analysis to indicate whether the respondents use similar criteria to evaluate these selected characteristics of barley in their purchasing decisions.

The second section of the survey contains stated preference questions that allow the test of hypotheses that:

1. Non-visual or non-identifiable traits are important to barley purchasers;
2. A known supplier is important to barley purchasers; and
3. The ability to trace back the barley varieties, field grown and all agronomic practices is important to barley purchasers.

The third section of the survey contains questions that provide general information such as how many feed mills have long-term contracting relationship with farmers, how many of them prefer a specific type of barley for feed, how much barley they purchase annually and so forth. The information is used to segment the data to set up different stated preference models for comparison purpose.

This chapter gives an analysis of the surveyed feed mills' responses including a brief examination on the market structure and concentration measures for the feed mills. Additional information gathered from direct interviews are reported. A summary on the average ranking of the barley attributes and a report of the factor analysis and stated preference results are presented. The results are used to discuss the potential for applying SCM in the Western Canadian feed barley industry.

6.2 The Surveyed Feed Mills

Feed mill responses from section 3 of the survey are analyzed to provide an overview of the sample. Of the surveyed feed mills, 44% marketed their feed mostly to the beef industry[7], 24% to the poultry, 20% to the pork and 12% to the dairy (Q1, S3[8]). These feedmills' barley purchases ranged from 400 tonnes to 100,000 tonnes a year (Q2, S3). Fifty-two percent of the respondents have some long-term contracts with barley sellers and 84% of those have contracted directly with farmers (Q9, S3). Ninety-two percent of the respondents test some barley for quality (Q5, S3).

Respondents were asked to list and rank the top four barley characteristics they use to evaluate barley quality. More than 90% of the respondents ranked "bushel weight" (Q6, S3) as the most important quality characteristic they evaluate in barley and 88% ranked "moisture level" or "foreign material or dockage" the next most important characteristic (Figure 6-1). The fourth most important characteristic was "uniform kernels". Less than 5% of the respondents ranked protein, starch or amino acids as the most important quality characteristic. This indicates that physical characteristics of barley are dominant criteria used to evaluate barley quality.

Table 6-1 indicates that 11out of 23 respondents (2 feed mills declined to disclose the quantity purchased) purchased 14,000 tonnes of barley or more annually (Q2, S3). Among these feed mills who purchase larger quantities of barley, 73% have or prefer to have long-term contracts with farmers and 66% consider that the Canadian Grain Commission (CGC) grading is ineffective in providing information for selecting suitable barley for feed.

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[7] Marketed mostly to beef industry means that the percentage of feed marketed to beef industry is more than that to dairy, pork or poultry industry

[8] Analyzed from question 1 in section 3 of the survey in Appendix I.

The segmented groups that on average purchase larger quantities of barley and have higher percentage of preferences for long-term contracts are those that:

1) have purchased hulless barley for feed,
2) have marketed the feed mostly to the beef industry, and
3) consider CGC grading ineffective to provide information for selecting suitable barley for feed.

The companies with these characteristics may have stronger preferences for contracting relationship with farmers or a higher potential to apply SCM.

Of those respondents who purchase hulless barley for feed, all of them prefer to have long-term contracts with farmers. Compared to those who do not purchase hulless barley, they have a higher percentage in the group that consider CGC grading ineffective and prefer a particular type of barley for feed (Table 6-1). This may indicate that they have stronger preferences for contracting relationships with barley farmers because most of them consider a particular type of barley more suitable for feed, which may not be easily acquired through open market transactions. The study by Jaikaran et al. (1998) shows that hulless barley is higher in protein than hulled barley. Most feed mixes using hulless barley have been sold to the hog industry (Canadian Grain Commission 1997). Feed mills that purchased hulless barley for feed mixes may prefer barley attributes that are more specific or responsive to the hog industry. According to TCE, the demand for specific product attributes may have a higher cost when using open market transactions. As well, many of them consider that the CGC grading, which focuses on physical characteristics of barley, is ineffective. This may imply that feed mills that purchased hulless barley do not think the quality of barley is reasonably represented by the physical characteristics.

Of those respondents who have marketed the feed mostly to the beef industry, 72% have indicated that they have or prefer to have long-term contract with farmers (Table 6-1). Compared to those who have marketed mostly to other livestock and poultry industries, they show a higher percentage preferring a particular type of barley for feed and stronger preferences for contracting relationships with barley farmers (Table 6-1). The study by Beauchemin and Rode (1998) suggests that for the cattle industry, the key to barley processing is maintaining a balance between over-processing and under-processing. Over-processing may cause acidosis and metabolic disorders whereas under-processing may reduce digestibility and animal performance. Feed mills who marketed their feed mostly to the beef industry may prefer to use a particular type of barley or contract with barley farmers to reduce the variability of barley quality in order to obtain the optimum degree of processing.

For the respondents who consider CGC grading ineffective, 69% of them have indicated that they have or prefer to have long-term contracts with farmers (Table 6-1). They have a higher percentage in purchasing hulless barley for feed, preferring a particular type of barley for feed and marketing the feed mostly to the beef industry (Table 6-1). These feed mill companies have stronger preferences for contracting relationship with farmers because they consider that the physical characteristics of barley, which are used in the CGC grading, do not provide the information of barley quality they require.

The above analysis from section 3 of the survey provides some information for SCM studies. First, a higher percentage of feed mills who purchase larger barley quantities, have or prefer to have long-term contracts with farmers. Second, feed mills, i) who purchase hulless barley, ii) who have marketed the feed mostly to the beef industry, and iii) who consider CGC grading ineffective, are those who purchase larger quantities of barley and have a higher percentage that prefer to have long-term contracts with farmers. Third, feed mills, who possess the characteristics (i),(ii) and (iii) above are more likely to consider a particular type of barley more suitable for feed. These companies may demand specific barley attributes for feed, which has a higher cost of searching through open markets. This conclusion will be compared to the results from the factor analysis and the stated preference analysis.

6.3 The Concentration Measure of the Feed Mills

The information about the concentration ratio of the feed mills relies on the voluntarily disclosure from the survey interviews. In total, ten feed mills were interviewed. Respondents reported that the largest four feed mills account for more than 75% of the feed mix and feed supplement sales to the livestock and poultry industries. That is to say, the 4-firm sales concentration ratio, CR_4 (Scherer and Ross 1990) in the Alberta feed mill industry is higher than 75%, which indicates an oligopoly market structure. However, the total amount of barley that the feed mills purchased for feed mix is quite minimal compared to the amount purchased by the beef feedlots. One feed mill manager suggested that a nearby large feedlot normally purchased 18 times more barley per year than his feed mill plant. Most respondents stated that their companies were price takers in the barley market. The price of barley was determined by deducting the basis from the Lethbridge price or paying a price competitive to the nearby beef feedlots. Although the feed mill industry is highly concentrated in structure, the major feed mills are unlikely to have any market power in the feed barley market. Nevertheless, the feed mills may have market power on their specialized feed products. This potential oligopoly power was not assessed.

6.4 The Direct Interviews

Ten out of 25 surveys were done by direct interviews, where additional questions were asked after the respondent had completed the questionnaires. The additional questions are:

1. Is there any factor that you think is important in the barley buying decision but has not been included in this survey?
2. Do you see any key changes happening in the feed industry now or in the future?
3. Do you think that the feed processing market is highly concentrated?

4. Do you think that your company differentiates itself by product quality or by location?

All respondents did not think that the survey omitted any important barley characteristics. Most respondents do not envisage any significant changes taking place in the feed industry. Only one respondent stated that he was aware of the new technology in scanning quality of barley and the future potential of growing specific crops for specific users. All respondents considered the feed processing market to be highly concentrated, leading by four major players. Most of them send samples to laboratories for quality testing. They indicated that their companies' possessed unique formulas for feed mix and differentiated themselves in the feed processing market by product quality and services. One feed mill revealed that they had been customizing feed formulation when requested by customers in the beef industry. A few revealed that they regularly purchased hulless barley for a separate bin of feed mix because it appealed to certain customers in the poultry industry.

Each of these feed mills set a minimum requirement for the visual checklist. If the barley does not meet the minimum requirement, the feed mills either reject the delivery or sell the barley to the nearby feedlots at a discount. Overall, these feed mill companies often experience inconsistency in barley supply and quality. At the moment, they rely on sending barley samples for quality testing and add supplements to maintain a consistent quality in their feed products.

Many respondents disclosed that they maintained long-term relationships with local farmers and preferred to deal directly with farmers. Barley sold by farmers has higher quality and it is preferred to barley from elevator companies because it is less blended. However, feed mill experiences in barley contracting were not very successful mostly due to the fear of being caught in price fluctuations, quality fluctuations or having to manage the costs from hedging.

Individual comments from the mail surveys regarding contracting experiences are summarized under categorized questions in Appendix II. Respondents who prefer to have long-term contracting relationship stated that contracts could help guarantee barley supply. Respondents who do not prefer to have long-term contracts with barley suppliers are mostly concerned about barley price changes and do not consider that contracts are necessary to lower the price risk.

The information provided from survey interviews reveals some obstacles for feed mills to consider when contracting with farmers. First, high environmental variability discourages feed mills from contracting before the crop is grown. Second, under the current contracting situations feed mills are unable to adequately manage price or quality risk. The costs of hedging against price or quality fluctuations are not justified to maintain long-term contracts. Third, barley farmers are not aware of the quality of their production or lack the control over quality due to high environmental variability and cannot guarantee barley quality to meet the minimum buying specifications of the feed mills.

6.5 The Average Rankings of the Barley Attributes

Table 6-2 presents the average rankings of the barley attributes from section 1 of the survey. The results are expected to give indications on whether there are buyer preferences for specific product attributes and business relationships. The results of the average rankings represent the relative perceptions held by the feed mills in Alberta on the physical, quality and seller characteristics of barley. Overall, the respondents rated the physical characteristics higher than the quality and seller characteristics in purchasing decisions. On a 7-point scale of 1 = Not Important and 7 = Very Important, the average rankings for physical characteristics are mostly rated above the rating of 6, with moisture level and bushel weight ranked the most important. This indicates that the physical characteristics dominate in barley buying decisions.

Most of the quality characteristics (level of starch, lysine and threonine) are rated below the mid-point of 4 (Table 6-2). Only protein yields a rating of 4.16, implying that non-visual quality characteristics are not the main concern in current barley buying decisions. The importance of seller characteristics that sellers who are personally known to the buyers and sellers who are willing to enter a long-term supply contract are also rated below the mid-point. Buyers are not actively looking for long-term contracting relationships or supply control. Seller's willingness to guarantee the quality of barley receives a rating of 6.24 whereas the seller's willingness to negotiate barley prices is given a rating of 4.60. Feed mills are more interested in quality control than price control. This may due to the fact that feed mills are price takers in the barley market. They have no control over barley prices but they often have an adequate barley supply at the market price.

Table 6-2 also presents the results of the segmented data gathered from direct interviews versus those from mail surveys. The quality characteristics were consistently rated lower in the results from direct interviews. The seller characteristic that the barley supplier is personally known to the buyers was rated lower in the results from the mail surveys. This may reflect that the buyer preferences are different across locations, as the feed mills contacted for direct interviews are concentrated in central Alberta. The differing survey responses may also be impacted by the presence of an interviewer. This interviewer bias is formally tested when the SPM results are presented. The results in Table 6-2 were not statistically tested for differences due to the relatively small sample size.

6.6 Statistical Results

The factor analysis and stated preference models are used to analyze the buyers' preferences. The factor analysis results indicate what product attributes the buyers use to evaluate the product quality and how buyers associate different product attributes. The stated preference results indicate what product attributes are important in buying decisions and whether there are different preferences by different market segments.

6.6.1 Factor Analysis Results

The factor analysis is used to evaluate the importance of various barley attributes and to identify any irrelevant attribute to be eliminated in the future analysis. The factor analysis was done on the correlation matrix using the eigenvalue 1 criterion to eliminate less important factors (Jobson 1991). The factor loadings and communalities (variable variance explained by the retained factors) are presented in Table 6-3. All the barley attributes have correlations with at least one of the factors that exceed 0.5, suggesting that none of the attributes that are considered should be dropped.

The result (Table 6-3) indicates that all the non-visual quality characteristics have the highest loading on the first factor (F1). Respondents on the whole, use very similar criteria to evaluate these barley quality characteristics. Respondents do not use similar criteria to evaluate quality and seller characteristics, nor do they use similar criteria to evaluate quality and physical characteristics. If non-visual quality characteristics of barley are important in purchasing decisions and barley buyers do not use physical characteristics as a proxy to evaluate non-visible quality characteristics of barley, this may indicate the potential for SCM to ensure delivery of desirable quality.

All physical characteristics except uniform kernels (KERNEL) have high factor loadings on the second factor (F2). The seller characteristics that a seller is known to the buyers (PKNOWN) and that a seller is willing to guarantee barley quality (QUALGTEE) also have the highest factor loading on the second factor (F2). Respondents associate barley quality with specific sellers. This may indicate the potential for SCM to enhance feed quality. However, respondents relate quality guarantee to bushel weight (BUSHWT) and foreign material (FNMAT) instead of protein (PRO) or starch (STCH). This indicates a lesser potential for SCM since buyers use physical characteristics to determine barley quality that can be easily identified and measured in open market transactions.

The respondents did not use similar criteria to evaluate uniform kernels (KERNEL) with bushel weight (BUSHELWT) but associate uniform kernels (KERNEL) with the overall quality of barley (QUAL). This may indicate that buyers rely on the physical appearance of the kernels to assess the overall quality of barley. The overall quality of barley (QUAL) was also evaluated with similar criteria the respondents used to evaluate the quality characteristics of barley as indicated by a high factor loading on the first factor (F1). Buyers associate both visible and non-visible barley characteristics to the overall quality of barley.

The factor analysis results (Table 6-3) indicate that the respondents use separate criteria to evaluate quality and seller characteristics. They also use separate criteria to evaluate quality and physical characteristics. The respondents relate quality guarantee to bushel weight and foreign material and associate these physical characteristics with specific sellers. This indicates that buyers use physical characteristics, which can be easily identified and measured in open market transactions, to evaluate barley quality. The factor analysis results do not show any evidence that feed mills may apply SCM to ensure delivery of the non-visible barley quality characteristics.

6.6.2 Stated Preference Results

Tables 6-4 to 6-12 present statistical results for the stated preference data. The results of the log likelihood ratio test (Table 6-13) indicate that the specified attributes in Model I, the non-segmented model are jointly important in explaining the "choice decision" variable at 95% confidence. The pseudo R^2 of 0.5702 indicates a reasonable measure of goodness-of-fit for Model I (Table 6-4). Table 6-4 presents estimated coefficients for Model I. Only the coefficients of the variables: bushel weight, price, detailed feed analysis and some of the barley varieties are statistically significant. The lowest bushel weight of 45 lb/bushel has a strong negative impact on the buyers' choice decisions. As the weight goes up, it has a positive effect on the probability of purchase but the effect slows down when it goes beyond 53 lb/bushel. The impact of price on the buyers' choice decisions is significant. As price goes up, it has a negative effect on the probability of purchase. The effect of detailed feed analysis on the probability of purchase is significantly positive. Buyers value information on non-visual quality characteristics of barley. The results indicate that if the barley variety is a 2-row feed, it significantly increases the probability of purchase. On the other hand, if the barley variety is a 6-row feed, it significantly decreases the probability of purchase. Although the coefficients for 2-row and 6-row malt varieties are statistically insignificant, the sign of the coefficients also indicate a positive preference for 2-row varieties and a negative preference for 6-row varieties (Table 6-4). Two-row varieties are often preferred because 2-row varieties have larger kernels and bushel weight (AAFRD 1999b). Feed mills prefer 2-row varieties because the bushel weight and uniform kernels are important characteristics in buying decisions as indicated by the average ranking results in section 6.5 and is consistent with the factor analysis results that feed mills associate kernel with barley quality.

The stated preference analysis was used to test the following hypothesis:

1. Non-visual or non-identifiable traits are important to barley purchasers;
2. A known supplier is important to barley purchasers; and
3. The ability to trace back the barley varieties, field grown and all agronomic practices is potentially important to barley purchasers.

The variable, detail feed analysis that provides information about non-visual traits on protein, starch and amino acids level, has a positive and statistically significant effect in barley purchase decisions (Table 6-4). The first hypothesis that non-visual or non-identifiable traits are important to barley purchasers cannot be rejected. The variable, known supplier, which indicates the barley comes from a supplier with whom the respondents has previous purchase experiences, has a small positive coefficient, which is not significantly different from zero (Table 6-4). The second hypothesis that a known supplier is important to barley purchasers is rejected. The effect of the variable, trace back, which indicates that the profiled barley can be traced back to its variety, field grown and agronomic practices, is also not significantly different from zero at 95% confidence level (Table 6-4). The third hypothesis, the ability to trace back barley is important to barley purchasers, is rejected.

Tables 6-5 to 6-12 present statistical results for Model II, III, IV, VIII, IX, X, XI and XII respectively. The results of the log likelihood tests for these segmented models indicate that the specified attributes are jointly important in explaining the "choice decision" variable at 95% confidence (Table 6-13). The pseudo R^2s for these models range from 0.56 to 0.68, which indicate a reasonable measure of goodness-of-fit.

For each segmented model, a Wald test was used to test whether the specified attributes are jointly important in explaining the "choice decision" of each segmented group. The Wald statistics indicate that the coefficients are not jointly significant (possibly due to small sample size) for the following groups:

i) feed mills who marketed their feed mostly to dairy industry in Model V,
ii) feed mills who marketed their feed mostly to pork industry in Model VI and
iii) feed mills who marketed their feed mostly to poultry industry in Model VII.
Their stated preference results are not reported in this study.

Wald tests were conducted on estimated coefficients of all variables to examine whether the effects of all specified barley attributes on the probability of choices are different between segmented groups. The results are presented in Table 6-14. The statistics show that there is no significant difference in coefficients for Model II that tests for differences between interview and mail surveys. As well, the signs of the coefficients are the same for the two groups (Table 6-5). This indicates that there is little interviewer bias introduced in direct interviews. There is no significant difference in coefficients for other segmented models (Table 6-14). This implies that the preferences of the segmented groups are, in general very similar.

Wald tests were conducted to examine whether there is significant difference in the effect of each barley attribute on the probability of choices between segmented groups. However, the following results are only indicative of possible difference since Model I is not significantly different from Models II to XII (Table 6-14). For model X (i.e those who prefer a particular type of barley for feed), there is statistically significant difference in the effect of price on the probability of choices (Table 6-14). The estimated coefficients of Model X in Table 6-10 indicate that the price level variables are mostly insignificant in explaining the "decision choice" variable. This may imply that this segmented group is less sensitive to price. For models III, IV and XI (i.e. those who marketed the feed mostly to beef/dairy industry, those who marketed mostly to beef industry and those who consider CGC grading effective), there is a statistically significant difference in the effect of the ability to trace back on the probability of choices (Table 6-14). The differences in the effect of the ability to trace back in some segmented groups may indicate that the concept of traceability is unfamiliar in the feed mill industry.

Overall, the physical characteristic "bushel weight" dominates the buying decision of each segmented group. For all segmented groups, the variable "detail feed analysis" has a statistically significant positive effect on the probability of choices except for those who consider the CGC grading system effective. This indicates that the role of CGC in grading barley is effective to barley buyers who do not value the information about the quality characteristics of barley. Many feed mills consider the CGC grading system ineffective because their grading standards are higher than the CGC's (Appendix II).

The preferences for 2-row or 6-row barley varieties are not statistically significant for most segmented groups. Only those who marketed their feed mostly to beef or dairy industry (Table 6-6), those who purchase larger quantities of barley (Table 6-9) and those who prefer a particular type of barley (Table 6-10) have significant preferences for 2-row varieties. None of the segmented groups has a significant preference for trace-back. Only one segmented group, those who marketed the feed mostly to beef or dairy industry, have a significantly positive preference for dealing with known suppliers (Table 6-6).

The stated preference results show that buyers value the information on the non-visual quality characteristics of barley but their buying decisions are dominated by the physical characteristic, bushel weight. The stated preference results show no evidence that buyers have strong preferences for the seller characteristics, known supplier and trace-back. This indicates that the potential for SCM in the feed barley market as perceived by feed mill managers and grain buyers, is not strong.

6.7 Conclusion

The previous chapters discuss economic theories related to SCM, identify SCM drivers, review the Canadian barley marketing system and conclude that the presence of SCM motivations in the barley supply chain can be analyzed by evaluating the buyers' preferences for feed barley. Buyers' preferences for non-readily identifiable attributes, such as the quality characteristics of barley, are potential SCM drivers for the Canadian feed barley supply chain. Also, buyers' preferences for seller characteristics such as trace-back capabilities on variety grown, willingness to guarantee barley quality or willingness to enter into long-term supply contract are motivations to establish strategic alliances with sellers to improve the quality of barley.

The survey on feed mill barley buyers shows that about 50% of the respondents have long-term contracts with barley farmers and most of them prefer to contract directly with farmers. Nevertheless, feed mills gave a low average ranking (Table 6-2) to the seller characteristic that the supplier is willing to enter into long-term supply contracts. High environmental variability can be one reason that discourages feed mills from having long-term contracts with barley sellers. Some feed mills consider that the cost of hedging against price or quality fluctuations are too high and are not justified to maintain long-term contracts.

The physical characteristics of barley dominate the feed mills' barley buying decisions. About 90% of the surveyed feed mills ranked bushel weight as the most important quality characteristic they evaluate in barley and 88% ranked moisture level or dockage the next most important characteristic. Moisture level and bushel weight received the highest average ranking. The factor analysis results show that feed mills relate quality guarantee to bushel weight and foreign material, implying that feed mills use physical characteristics to evaluate barley quality. Consistent with the scaling and the factor analysis results, the stated preference analysis shows that bushel weight dominates the feed mills' buying decisions.

Few respondents ranked the quality characteristics of barley such as protein and starch as the important quality characteristic they evaluate in barley. Most quality characteristics received an average ranking below the mid-point of the scale. The factor analysis shows that feed mills relate quality characteristics to the overall quality of barley but they do not relate them to quality guarantee. This may be due to high environmental variability. Feed mills often experience inconsistency in barley quality and are aware that farmers sometimes have little control over the quality. The ranking and factor analysis examine what feed mills currently evaluate. SPM can evaluate future choices or preferences if these choices were available.

The stated preference techniques found that there is a significant preference for a detailed feed analysis of the quality characteristics of barley if it were available. The feed mill respondents value information about the quality characteristics of barley. The survey responses show that 92% of the respondents test some barley for quality. At the moment, feed mills rely on sending samples to the laboratories for quality testing. This is one cost of using open markets when quality information is not conveyed. When the data are segmented, the stated preference results show that feed mills who consider the CGC grading system effective do not have a significant preference for the detailed feed analysis. This may imply that a better grading system may help reduce the cost of using open markets.

The advancement in feed evaluation technology is identified as a potential driver for SCM. The survey interviews show that feed mills currently do not envisage any significant changes taking place in the feed industry. Only one respondent envisages the future potential of growing specific crops for specific users. The changes in regulatory environment are also identified as potential drivers for SCM. None of the survey responses relate any issues or concerns that may cause any potential requirement of trace-back in the feed barley industry. The stated preference analysis shows that respondents currently are indifferent to the seller characteristics, known supplier and trace back. The statistical test results show that there are differences in the effect of the variable "trace back" in some segmented models. This implies that the concept of traceability is unfamiliar to many respondents in the feed mill industry.

The Alberta feed mill market is highly concentrated based on the information gathered from the survey interviews. Nevertheless, the feed mills do not have any market power in the barley market because the total amount of barley that feed mills purchased for feed mix is quite minimal compared to the amount purchased by the beef feedlots. Therefore, feed mills are unlikely to have the motivation to integrate with input suppliers to gain market power.

In conclusion, there is no evidence that the advancement in technology or the changes in regulatory environment are driving feed mill to initiate more vertical coordination in the feed barley and livestock markets. Nor is there any evidence that feed mills are looking for long-term contracting relationships with barley sellers to reduce the cost of quality testing. The analysis of the feed mill buyers' preferences shows that although feed mills value the information on the non-visual quality characteristics of barley, their buying decisions are still dominated by the physical characteristic, bushel weight. As bushel weight is easily measured in open market transactions, the potential for SCM between feed mills and the feed barley market is not strong.

Table 6- 1 The Profile of the Surveyed Feed Mills Companies

		Average barley purchase (tonnes per year)	Consider CGC* grading is effective	Marketed the feed most to beef industry	Have or prefer to have long term contract with farmers	Preferred a specific type of barley	Purchased hulless barley for feed
Total	N=25	18,072	48%	44%	64%	28%	32%
Direct interview	**Yes** (N=9)	19,760	44%	44%	55%	44%	33%
	No (N=16)	14,880	50%	44%	69%	25%	31%
Have or prefer to have long-term contract with farmers (S3,Q9)**	**Yes** (N=16)	20,600	44%	50%	NA	25%	50%
	No (N=9)	9,600	56%	33%	NA	33%	0%
Purchased hulless barley for feed (S3, Q8)	**Yes** (N=8)	27,800	38%	38%	100%	38%	NA
	No (N=17)	11,370	53%	47%	47%	24%	NA
Prefer specific type of barley (S3, Q3)	**Yes** (N=7)	26,100	43%	57%	57%	NA	43%
	No (N=18)	12,950	50%	39%	67%	NA	28%
Marketed the feed most to beef industry (S3, Q1)	**Yes** (N=11)	20,800	45%	NA	72%	36%	27%
	No (N=14)	13,300	50%	NA	57%	21%	36%
Consider CGC grading is (S3, Q4) effective	**Yes** (N=12)	9,260	NA	42%	58%	25%	25%
	No (N=13)	23,420	NA	46%	69%	31%	38%
Barley Purchase of 14,000 tonnes or more (S3, Q2)	**Yes** (N=11)	NA	36%	27%	73%	27%	45%
	No (N=12)	NA	66%	67%	67%	33%	25%

* CGC - Canadian Grain Commission
**(S3,Q9) – Question 9 in Section 3 of the survey (Appendix I)

Table 6- 2 **The of Average Rankings of the Barley Attributes**

Average Rankings

VARIABLES	**Overall** (N=25)	**Direct Interview** (N=9)	**Mail Survey** (N=16)
Overall Quality of Barley (S1,Q1)*	5.44	4.89	5.75
Quality Characteristics:			
Protein Level (S1,Q2)	4.16	3.22	4.69
Lysine Level (S1,Q3)	3.76	3.33	4.00
Threonine Level (S1, Q4)	3.52	3.00	3.81
Starch Level (S1, Q5)	3.68	2.78	4.19
Physical Characteristics:			
Moisture Level (S1, Q6)	6.60	6.56	6.63
Foreign Material (S1, Q7)	6.28	6.00	6.44
Bushel Weight (S1, Q8)	6.56	6.67	6.50
Uniform Kernels (S1, Q9)	5.52	5.56	5.50
Seller Characteristics:			
Personally Known to the Buyers (S1, Q10)	3.24	3.78	2.94
Willing to Negotiate the Price of Barley (S1, Q11)	4.60	4.78	4.50
Willing to Guarantee the Quality of Barley (S1, Q12)	6.24	6.11	6.31
Willing to Enter a Long-Term Supply Contract (S1, Q13)	3.40	3.22	3.50

* (S1,Q1) – Question 1 in Section 1 of the survey (Appendix I)

Note: the average rankings are measured on a 7-point scale of 1 = Not Important and 7 = Very Important

Table 6- 3 Factor Analysis Results for the Non-segmented Data

VARIABLES	F1	F2	F3	F4	COMMUNALITY
PRO	**-0.78**	0.12	-0.27	-0.05	0.70
LYS	**-0.91**	0.12	0.10	-0.18	0.88
THRE	**-0.92**	0.02	0.17	-0.08	0.88
STCH	**-0.85**	-0.11	0.16	-0.17	0.78
FNMAT	-0.46	**0.55**	-0.44	0.04	0.70
BUSHWT	0.19	**0.77**	-0.16	-0.27	0.72
QUALGTEE	-0.06	**0.78**	0.24	0.14	0.69
PKNOWN	-0.19	**0.70**	0.20	0.08	0.57
MOIST	0.09	**0.53**	**-0.58**	0.03	0.63
NGPRICE	-0.03	0.19	**0.83**	0.03	0.72
CONTWILL	-0.52	0.30	**0.56**	-0.02	0.68
KERNEL	-0.17	0.00	-0.08	**-0.92**	0.88
QUAL	**-0.58**	-0.05	0.21	**-0.62**	0.77

Note:

PRO - Protein level
LYS - Lysine level
THRE - Threonine level
STCH - Starch level
FNMAT - Foreign material
BUSHWT - Bushel weight
QUALGTEE - Seller who is willing to guarantee the quality of barley
PKNOWN - Seller who is personally known to the buyers
MOIST - Moisture level
NGPRICE - Seller who is willing to negotiate prices of barley
CONTWILL - Seller who is willing to enter long-term supply contract
KERNEL - Uniform kernels
QUAL - Overall quality of barley

Table 6- 4 Estimated Coefficients for Model I (Non-segmented Model)

PRODUCT ATTRIBUTE	ESTIMATED COEFFICIENT
	Non-segmented data (N=200)
PROBABILITY OF PURCHASE:	
Weight 1 (45 lb/bushel)	-6.4150*
Weight 2 (49 lb/bushel)	1.8697*
Weight 3 (53 lb/bushel)	2.4044*
Weight 4 (57 lb/bushel)	2.1409*
Detailed Feed Analysis	0.7157*
Known Supplier	0.1781
2- Row Malt Variety	0.2841
6- Row Malt Variety	-0.3762
2- Row Feed Variety	0.6390*
6- Row Feed Variety	-0.5469**
Trace Back	-0.0936
Price 1 ($80/tonne)	1.5046*
Price 2 ($90/tonne)	0.6743*
Price 3 ($100/tonne)	-0.7421**
Price 4 ($110/tonne)	-1.4368*
Pseudo R^2	0.5702

*SIGNIFICANT AT 5%
**SIGNIFICANT AT 10%

Table 6- 5 **Estimated Coefficients for Model II (Direct Interview Versus Mail Back)**

PRODUCT ATTRIBUTE	ESTIMATED COEFFICIENT	
	Direct Interview (N=72)	Mail Back (N=128)
PROBABILITY OF PURCHASE:		
Weight 1 (45 lb/bushel)	-6.1871*	-7.3054*
Weight 2 (49 lb/bushel)	1.7792*	2.2686*
Weight 3 (53 lb/bushel)	2.5071*	2.4001*
Weight 4 (57 lb/bushel)	1.9008*	2.6367*
Detailed Feed Analysis	0.6819*	0.9531*
Known Supplier	0.0090	0.4042
2- Row Malt Variety	0.5831	0.1173
6- Row Malt Variety	-0.4526	-0.2676
2- Row Feed Variety	0.9027	0.5386
6- Row Feed Variety	-1.0333**	-0.3883
Trace Back	0.1170	-0.1988
Price 1 ($80/tonne)	1.6025*	1.6294*
Price 2 ($90/tonne)	0.8522	0.5404
Price 3 ($100/tonne)	-1.1799**	-0.2185
Price 4 ($110/tonne)	-1.2748*	-1.9513*
Pseudo R^2	0.5982	
Wald Statistics:		
H_0 = all direct interview coefficients equal 0	26.95***	
H_0 = all mail back coefficients equal 0	49.94***	

*SIGNIFICANT AT 5%

**SIGNIFICANT AT 10%

*** REJECTED THE NULL HYPOTHESIS AT 95% CONFIDENCE LEVEL

Table 6- 6 **Estimated Coefficients for Model III (Those Who Marketed the Feed Mostly to Beef /Dairy Industry Versus Those Marketed Mostly to Pork/Poultry)**

PRODUCT ATTRIBUTE	ESTIMATED COEFFICIENT	
	Marketed the Feed Mostly to	
	(i) Beef or Dairy Industry (N=112)	(ii) Pork or Poultry Industry (N=88)
PROBABILITY OF PURCHASE:		
Weight 1 (45 lb/bushel)	-6.5152*	-6.0840*
Weight 2 (49 lb/bushel)	1.5546*	1.9560*
Weight 3 (53 lb/bushel)	2.4520*	1.8721*
Weight 4 (57 lb/bushel)	2.5087*	2.2559*
Detailed Feed Analysis	0.7884*	0.9311*
Known Supplier	0.6129*	-0.0698
2- Row Malt Variety	-0.2190	0.7245
6- Row Malt Variety	0.3095	-0.5968
2- Row Feed Variety	0.3118*	0.6957
6- Row Feed Variety	-0.4024	-0.8234
Trace Back	0.3941	-0.2841
Price 1 ($80/tonne)	1.1151*	1.9164*
Price 2 ($90/tonne)	1.0353*	0.3506
Price 3 ($100/tonne)	-0.1624	-0.5193
Price 4 ($110/tonne)	-1.9879*	-1.7476*
Pseudo R^2	0.5621	
Wald Statistics:		
H_0 = all coefficients for segmented group (i) equal 0	49.53**	
H_0 = all coefficients for segmented group (ii) equal 0	50.40**	

*SIGNIFICANT AT 5%

** REJECTED THE NULL HYPOTHESIS AT 95% CONFIDENCE LEVEL

Table 6- 7 **Estimated Coefficients for Model IV (Those Who Marketed the Feed Mostly to Beef Industry Versus Those Did Not)**

	ESTIMATED COEFFICIENT	
PRODUCT ATTRIBUTE	**Marketed Most of their Feed to Beef Industry**	
	(i) **Yes** **(N=88)**	**(ii)** **No** **(N-112)**
PROBABILITY OF PURCHASE:		
Weight 1 (45 lb/bushel)	-6.7053*	-6.8672*
Weight 2 (49 lb/bushel)	1.9862*	2.2367*
Weight 3 (53 lb/bushel)	2.3690*	2.4684*
Weight 4 (57 lb/bushel)	2.3501*	2.1608*
Detailed Feed Analysis	0.7681*	0.9188*
Known Supplier	0.3951	0.0075
2- Row Malt Variety	-0.2117	0.7302**
6- Row Malt Variety	0.0139	-0.7982
2- Row Feed Variety	0.6398	0.8925
6- Row Feed Variety	-0.4420	-0.8246
Trace Back	0.2236	-0.3923
Price 1 ($80/tonne)	1.5234*	1.3749*
Price 2 ($90/tonne)	1.0939*	0.8701**
Price 3 ($100/tonne)	-1.1099*	-0.1643
Price 4 ($110/tonne)	-1.5074*	-2.0807*
Pseudo R^2	0.5930	
Wald Statistics:		
H$_0$ = all coefficients for segmented group (i) equal 0	39.40***	
H$_0$ = all coefficients for segmented group (ii) equal 0	42.53***	

*SIGNIFICANT AT 5%

**SIGNIFICANT AT 10%

*** REJECTED THE NULL HYPOTHESIS AT 95% CONFIDENCE LEVEL

Table 6- 8 Estimated Coefficients for Model VIII (Those Who Have Long-term Contracts with Farmers Versus Those Do Not)

PRODUCT ATTRIBUTE	ESTIMATED COEFFICIENT	
	Have Long-term Contracts with Farmers	
	(i) Yes (N=112)	(ii) No (N=88)
PROBABILITY OF PURCHASE:		
Weight 1 (45 lb/bushel)	-6.7609*	-6.6356*
Weight 2 (49 lb/bushel)	1.9135*	2.0898*
Weight 3 (53 lb/bushel)	2.2434*	2.6078*
Weight 4 (57 lb/bushel)	2.6039*	1.9381*
Detailed Feed Analysis	0.0608*	0.7246*
Known Supplier	0.4184	0.1528
2- Row Malt Variety	0.4024	0.2022
6- Row Malt Variety	-0.2577	-0.5379
2- Row Feed Variety	0.8221	0.6062
6- Row Feed Variety	-0.9668*	-0.2706
Trace Back	0.0768	-0.0053
Price 1 ($80/tonne)	2.3556*	0.6302
Price 2 ($90/tonne)	0.4762	1.2546*
Price 3 ($100/tonne)	-0.6542	-0.5639
Price 4 ($110/tonne)	-2.1776*	-1.3118*
Pseudo R^2	0.5999	
Wald Statistics:		
H_0 = all coefficients for segmented group (i) equal 0	46.69**	
H_0 = all coefficients for segmented group (ii) equal 0	34.63**	

*SIGNIFICANT AT 5%

** REJECTED THE NULL HYPOTHESIS AT 95% CONFIDENCE LEVEL

Table 6- 9 Estimated Coefficients for Model IX (Those Who Have Larger Barley Quantity Purchase Versus Those Have Less)

PRODUCT ATTRIBUTE	ESTIMATED COEFFICIENT The Quantity of Barley Purchase	
	(i) Large (N=88)	(ii) Small (N=96)
PROBABILITY OF PURCHASE:		
Weight 1 (45 lb/bushel)	-5.8859*	-12.6483*
Weight 2 (49 lb/bushel)	1.6816*	3.6321*
Weight 3 (53 lb/bushel)	2.1813*	4.5892*
Weight 4 (57 lb/bushel)	2.0231*	4.4270*
Detailed Feed Analysis	0.5858*	0.9476*
Known Supplier	0.3142	0.6475
2- Row Malt Variety	0.7131**	-0.2574
6- Row Malt Variety	-1.0579**	0.5157
2- Row Feed Variety	0.9365**	0.4390
6- Row Feed Variety	-0.5917	-0.6973
Trace Back	-0.2673	0.1122
Price 1 ($80/tonne)	1.6258*	3.1946*
Price 2 ($90/tonne)	1.0375*	0.4111
Price 3 ($100/tonne)	-0.4286	-1.6859**
Price 4 ($110/tonne)	-2.2347*	-1.9470*
Pseudo R^2	0.6811	
Wald Statistics:		
H_0 = all coefficients for segmented group (i) equal 0	38.31***	
H_0 = all coefficients for segmented group (ii) equal 0	28.73***	

*SIGNIFICANT AT 5%

**SIGNIFICANT AT 10%

*** REJECTED THE NULL HYPOTHESIS AT 95% CONFIDENCE LEVEL

Table 6- 10 Estimated Coefficients for Model X (Those Preferred a Particular Type of Barley Versus Those do not)

PRODUCT ATTRIBUTE	ESTIMATED COEFFICIENT	
	Preferred a Particular Type of Barley	
	(i) Yes (N=56)	(ii) No (N=144)
PROBABILITY OF PURCHASE:		
Weight 1 (45 lb/bushel)	-5.0298*	-7.2527*
Weight 2 (49 lb/bushel)	1.0612	2.1588*
Weight 3 (53 lb/bushel)	2.6203*	2.5897*
Weight 4 (57 lb/bushel)	1.3483*	2.5043*
Detailed Feed Analysis	1.2171*	0.7512*
Known Supplier	0.2643	0.2523
2- Row Malt Variety	-0.0904	0.3048
6- Row Malt Variety	0.6659	-0.6972
2- Row Feed Variety	1.0323**	0.7144
6- Row Feed Variety	-1.6078*	-0.3221
Trace Back	0.6488	-0.2379
Price 1 ($80/tonne)	1.2163*	2.1480*
Price 2 ($90/tonne)	-0.8009	0.7782**
Price 3 ($100/tonne)	0.5443	-1.0518**
Price 4 ($110/tonne)	-0.9597	-1.8745*
Pseudo R^2	0.6075	
Wald Statistics:		
H_0 = all coefficients for segmented group (i) equal 0	21.77***	
H_0 = all coefficients for segmented group (ii) equal 0	56.54***	

*SIGNIFICANT AT 5%

**SIGNIFICANT AT 10%

*** REJECTED THE NULL HYPOTHESIS AT 95% CONFIDENCE LEVEL

Table 6- 11 **Estimated Coefficients for Model XI (Those Consider CGC Grading System Effective Versus Those Do Not)**

PRODUCT ATTRIBUTE	**ESTIMATED COEFFICIENT**	
	Consider CGC Grading System Effective	
	(i) Yes (N=96)	**(ii) No (N=104)**
PROBABILITY OF PURCHASE:		
Weight 1 (45 lb/bushel)	-5.2301*	-9.6911*
Weight 2 (49 lb/bushel)	1.6659*	3.0880*
Weight 3 (53 lb/bushel)	1.9376*	3.5776*
Weight 4 (57 lb/bushel)	1.6265*	3.0254*
Detailed Feed Analysis	0.3396	1.4986*
Known Supplier	0.6360	-0.1160
2- Row Malt Variety	-0.3632	0.4796
6- Row Malt Variety	0.0401	-0.2335
2- Row Feed Variety	0.4581	0.7295
6- Row Feed Variety	-0.1351	-0.9757**
Trace Back	-0.0861	0.1345
Price 1 ($80/tonne)	0.8912*	2.0331*
Price 2 ($90/tonne)	1.3838*	0.3369
Price 3 ($100/tonne)	-0.6349	-1.2686*
Price 4 ($110/tonne)	-1.6400*	-1.1014*
Pseudo R^2	0.6160	
Wald Statistics:		
H_0 = all coefficients for segmented group (i) equal 0	38.75***	
H_0 = all coefficients for segmented group (ii) equal 0	37.32***	

CGC stands for Canadian Grain Commission

*SIGNIFICANT AT 5%

**SIGNIFICANT AT 10%

*** REJECTED THE NULL HYPOTHESIS AT 95% CONFIDENCE LEVEL

Table 6- 12 Estimated Coefficients for Model XII (Those Who Purchase Hulless Barley for Feed Versus Those Do Not)

PRODUCT ATTRIBUTE	ESTIMATED COEFFICIENT	
	Purchased Hulless Barley for Feed	
	(i) Yes (N=64)	(ii) No (N=136)
PROBABILITY OF PURCHASE:		
Weight 1 (45 lb/bushel)	-6.1871*	-7.3054*
Weight 2 (49 lb/bushel)	1.7792*	2.2686*
Weight 3 (53 lb/bushel)	2.5071*	2.4001*
Weight 4 (57 lb/bushel)	1.9008*	2.6367*
Detailed Feed Analysis	0.6819*	0.9531*
Known Supplier	0.0090	0.4042
2- Row Malt Variety	0.5831	0.1173
6- Row Malt Variety	-0.4526	-0.2676
2- Row Feed Variety	0.9027	0.5386
6- Row Feed Variety	-1.0332**	-0.3883
Trace Back	0.1170	-0.1988
Price 1 ($80/tonne)	1.6025*	1.6294*
Price 2 ($90/tonne)	0.8522	0.5404
Price 3 ($100/tonne)	-1.1800**	-0.2185
Price 4 ($110/tonne)	-1.9512*	-1.9512*
Pseudo R^2	0.5982	
Wald Statistics:		
H_0 = all coefficients for segmented group (i) equal 0	26.95***	
H_0 = all coefficients for segmented group (ii) equal 0	49.94***	

*SIGNIFICANT AT 5%

**SIGNIFICANT AT 10%

*** REJECTED THE NULL HYPOTHESIS AT 95% CONFIDENCE LEVEL

Table 6- 13 Results of Log Likelihood Ratio Tests

Hypothesis Testing: **H_0 = all coefficients equal zero**		**Log Likelihood**			
	Obs	**Unrestricted Model**	**Restricted Model**	**χ^2 statistics**	**DF**
Model I	200	-94	-220	252*	12
Model II	200	-88	-220	264*	24
Model III	200	-96	-220	248*	24
Model IV	200	-89	-220	262*	24
Model V	200	-91	-220	258*	24
Model VI	200	-86	-220	268*	24
Model VII	200	-86	-220	268*	24
Model VIII	200	-88	-220	264*	24
Model IX	184	-64	-202	276*	24
Model X	200	-86	-220	268*	24
Model XI	200	-84	-220	272*	24
Model XII	200	-88	-220	264*	24

* REJECTED THE NULL HYPOTHESIS AT 95% CONFIDENCE LEVEL
Obs - Observations
DF - Degrees of Freedom

Model I - Non-segmented Model
Model II - Direct Interview Versus Mail Back
Model III - Those Who Marketed the Feed Mostly to Beef/Dairy Industry Versus Those Marketed Mostly to Pork/Poultry
Model IV - Those Who Marketed the Feed Mostly to Beef Industry Versus Those Did Not
Model V - Those Who Marketed the Feed Mostly to Dairy Industry Versus Those Did Not
Model VI - Those Who Marketed the Feed Mostly to Pork Industry Versus Those Did Not
Model VII - Those Who Marketed the Feed Mostly to Poultry Industry Versus Those Did Not
Model VIII - Those Who Have Long-term Contracts with Farmers Versus Those Do Not
Model IX - Those Who Have Larger Barley Quantity Purchase Versus Those Have Less
Model X - Those Preferred a Particular Type of Barley Versus Those Do Not
Model XI - Those Consider CGC Grading System Effective Versus Those Do Not
Model XII - Those Who Purchase Hulless Barley for Feed Versus Those Do Not

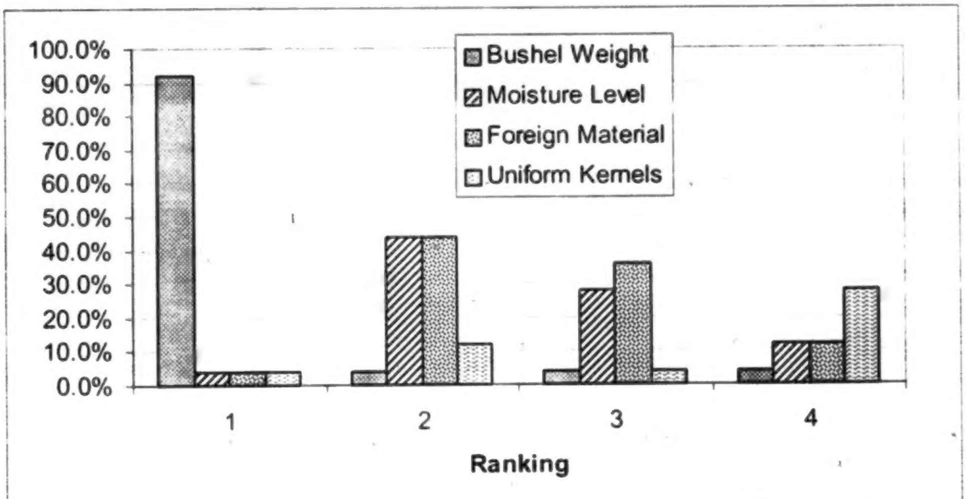
Table 6- 14 **Results of Testing the Effect of Stated Preference Variables on Segmented Models**

Hypothesis Testing:	**χ^2 statistics**							
H_0 = between segmented groups, there is no difference in the effect of :	**Model II**	**Model III**	**Model IV**	**Model VIII**	**Model IX**	**Model X**	**Model XI**	**Model XII**
All variables (df=12)	9.09	9.05	10.58	10.09	9.3	13.36	13.26	9.09
Bushel weight (df=3)	1.2	1.51	0.16	1.37	5.3	3.45	4.37	1.20
Detail feed analysis (df=1)	0.47	0.12	0.085	0.09	0.64	0.99	6.1	0.47
Known supplier (df=1)	1.04	3.09	0.67	0.43	0.48	0.001	1.97	1.04
Barley varieties (df=3)	1.21	2.84	2.27	0.92	1.72	3.04	2.07	1.21
Ability to trace back (df=1)	0.68	2.85**	2.98**	0.043	0.6	2.6	6.26*	0.68
Price (df=3)	2.02	2.54	3.13	5.99	2.92	6.89**	4.68	2.03

* THE NULL HYPOTHESIS IS REJECTED AT 95% CONFIDENCE LEVEL
** THE NULL HYPOTHESIS IS REJECTED AT 90% CONFIDENCE LEVEL
df – degrees of freedom

Model II - Direct Interview Versus Mail Back
Model III - Those Who Marketed the Feed Mostly to Beef/Dairy Industry Versus Those Marketed Mostly to Pork/Poultry
Model IV - Those Who Marketed the Feed Mostly to Beef Industry Versus Those Did Not
Model VIII - Those Who Have Long-term Contracts with Farmers Versus Those Do Not
Model IX - Those Who Have Larger Barley Quantity Purchase Versus Those Have Less
Model X - Those Preferred a Particular Type of Barley Versus Those Do Not
Model XI - Those Consider CGC Grading System Effective Versus Those Do Not
Model XII - Those Who Purchase Hulless Barley for Feed Versus Those Do Not

Figure 6- 1 **Most Important Barley Characteristics Used to Evaluate Barley Quality: Ranking Percentages for Bushel Weight, Moisture Level, Foreign Material and Uniform Kernels**



Source: Feed Mills Survey 1999, question 6 in section 3 (Appendix I)

CHAPTER SEVEN: Conclusion and Further Research

7.1 Conclusion

This study examines the potential for SCM in the Canadian feed barley industry. Previous studies (Hobbs and Young 1999; Martinez 1999; Martinez et al. 1997) observe that the use of contracting or VC is increasingly important in the Canadian and the US agricultural industries. VC and SCM have been analyzed as alternatives to open market systems because they are considered more effective in dealing with specific consumer preferences and issues that affect various businesses along the food supply chains (Hobbs and Young 1999; Boehlje et al. 1998). Recent studies suggest that various US agricultural industries adopt VC/SCM to increase productivity, reduce the cost of production and improve product quality. For instance, Martinez et al. (1997) studied the increasing VC in the US pork industry and suggested that VC helped to ensure processing plants operate at optimum capacity and consumers benefited from lower pork production costs and a large supply of high-quality pork products. Martinez (1999) studied the US broiler industry and suggested that production contracts between broiler growers and feed suppliers encouraged rapid adoption of new technology. Hobbs and Young (1999) studied various Canadian and US grain industries and suggested that production contracts were used to improve product quality and ensure food safety. The study of the potential for SCM in the Canadian feed barley industry can provide information for producers and policy-makers to analyze the competitiveness of participants in the barley supply chain.

This study reviews economic theories and studies that are applicable for SCM. In light of the theories, this study identifies the following motivations for SCM:

1. Economics Rationality/Efficiency Motives
2. Investment/Structural Restraints
3. Strategic Management Motives
4. Risk Reduction Motives

The economics rationality/efficiency motives are the general concerns for reducing production costs and increasing business profits. The investment/structural restraints are the constraints related to asset and product specificity or the exogenous factors such as the market structure. The strategic management motives are firms' decisions to create entry barriers to reduce competition and increase monopolistic profits or to share information to increase consumer responsiveness. The risk reduction motives are concerns for maintaining consistency in resource supply as well as consumer demand and product quality.

This study reviews the Canadian barley marketing system. Based on the review, both SCM drivers and open market drivers for the Canadian feed barley industry are identified. The potential SCM drivers identified for the Canadian feed barley are the motivations for:

1. contracting specific barley varieties for specific feed rations;
2. reducing the cost of searching for feed barley of high feeding value;
3. maintaining consistent supply of feed barley due to short-term inelastic demand;
4. increasing control of input resources to secure the high asset specificity in livestock production; and
5. establishing information sharing system to enhance customer responsiveness and traceability of products to increase consumer confidence in food safety.

On the other hand, the open market drivers are:

1. high number of agents both in barley and livestock industries;
2. government policies that emphasize standardization of grain quality based on some readily identifiable characteristics;
3. feed barley market being inseparable from the malting barley market;
4. non-specific assets for investments in barley production;
5. high environmental variability in barley production; and
6. improvements in feed testing technology that may lead to low cost, accurate and quick feed test results.

The presence of SCM motivations in the barley supply chain is analyzed by evaluating the buyers' preferences for feed barley. A survey of feed mill barley buyers was conducted in Alberta in November 1999. Feed mills possess information about the users' preferences for animal feeds and are presumed to be sensitive to feed quality.

The survey response shows no evidence that feed mills are looking for long-term contracting relationships with barley farmers to reduce the cost of searching for feed barley of high feeding value. First, the quality characteristics such as protein and starch that indicate the feeding value of barley received low average rankings. Second, information on the quality characteristics is valued by feed mills but it is not a dominant factor in the buying decisions. Third, due to high environmental variability, feed mills prefer to select barley after the crop. Some feed mills stated that the costs of hedging against price or quality fluctuations are too high and currently are not justified for maintaining long-term contracts. These feed mills rely on sending samples to the laboratories for quality testing.

There is little evidence showing that feed mills would like to contract specific barley varieties for specific rations. Only one feed mill stated that they had been customizing feed formulation as requested by customers in the beef industry. Only one feed mill manager anticipated the future potential of growing specific crops for specific users. Just a few revealed that they regularly purchased hulless barley for a separate bin of feed mix.

The seller characteristic that the supplier is willing to enter into long-term supply contract was considered unimportant by the feed mills and received a low average ranking. This indicates that feed mills are not looking for long-term contracting relationships to maintain consistent supply of feed barley. Many feed mills are aware of the high environmental variability and farmers do not have adequate control over the barley quality and supply.

The Alberta feed mill market is highly concentrated based on the information gathered from the survey interviews. The four major feed mills account for more than 75% of the feed mix and feed supplement sales to the livestock and poultry industries. This indicates an oligopoly market structure. Nevertheless, the feed mills do not have any market power in the barley market because the total amount of barley that feed mills purchase for feed mix is quite minimal compared to the amount purchased by the beef feedlots. The feed mills are unlikely to have the motivation to integrate with input suppliers to gain market power.

There is no evidence showing that feed mills are considering setting up an information sharing system to enhance customer responsiveness and traceability of products. First, none of the survey response relates any issues or concerns that may potentially require a trace-back system in the feed barley industry. Second, the stated preference analysis shows that respondents are indifferent to the seller characteristics, known supplier and trace back. Third, the statistical test results show that there are differences in the effect of the variable "trace back" on the probability of choices between some segmented models. This implies that the concept of traceability is unfamiliar in the feed mill industry.

The potential SCM drivers identified for the Canadian feed barley in the literature and market review are not identified as important from this sample survey of feed mills. SCM is not a part of the awareness of barley buyers at feed mills. Further feed mill industry research needs to be conducted by interviewing other senior executives in the feed mill industry.

7.2 Implications for the Feed Barley Supply Chain

This study has identified the potential SCM drivers for the feed barley supply chain, namely the motivation to search for barley with high feeding value, to contract specific barley varieties for specific livestock rations and to increase traceablity by an information-sharing system between the livestock and feed barley industries. The survey indicates that most of the respondents bear the cost of quality testing because open market transactions do not adequately convey quality information. Nevertheless, the empirical test of this study shows no evidence that the feed mills' buying decisions revealed any SCM motivations. This may be due to the current structure of the Canadian barley marketing system. Low market concentrations in the barley and livestock industries increase the cost of managing production contracts. Significant price premiums for malting barley direct resources from growing barley varieties with high feeding value to varieties with high malt potential. As well the roles of the institutions in the Canadian barley marketing system have been designed to facilitate barley markets that are more suitable for open market transactions. For instance, the CGC grading and the Western barley futures market define barley quality by bushel weight and dockage which can be easily measured in open market transactions but may not be highly correlated with the feeding value of barley.

SCM implicitly assumes that marketing system is manageable and the organizations and institutions can be shaped to support an efficient system (Zylbersztajn and Farina 1998). Changes that may help reduce the cost of conveying quality information in the feed barley market includes:

1. a grading system that define barley quality in term of feeding value. Instead of measuring feeding value to one single system, the grading should measure the ideal nutritional value with respect to each livestock market.
2. a market mechanism that may separate feed barley market from the malting barley market such as pricing feed barley closely to its feeding value.
3. a market structure that may reduce the cost of contract management such as forming farmer co-operatives or alliances to reduce the variation in barley

variety or quality and source a number of small contracts into one supply contract with feed mills and livestock producers.

4. a marketing agency (similar to the CIGI) that takes the role to test and develop specific barley varieties for specific livestock rations, to educate feed mills and livestock producers on the benefits of barley with high feeding value and to evaluate technology for optimum processing of barley as feed.

7.3 Further Research

For SCM studies, it is important to identify whether there is a specific demand, production or regulatory requirement for each barley market. For instance, quality characteristics such as the amino acids, lysine and threonine, are expected to have higher feeding value for swine diets. The average survey rankings of the lysine, threonine and starch level by the feed mills, who have marketed the feed mostly to the pork industry, are higher than that of those who marketed to other livestock industries. The sample size for those companies (N=5) was too small to conduct hypothesis tests and the results were not reported or discussed in this study. Nevertheless, it indicates that the pork industry may demand specific barley quality characteristics in the future. Research could be conducted in each of the livestock and poultry industry in Alberta. The sample sizes are larger and would enable the surveys to be designed for a specific livestock sector.

This study investigated the barley market and surveyed one segment in the barley supply chain, the feed mills. There are other major players in the supply chain such as the livestock producers, the meat processors and packers. Further research into the potential for SCM driven by any of these players can be explored.

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APPENDIX I: Sample of the Feed Barley Survey

Section I

Assuming the following traits are under consideration when you purchase FEED BARLEY. Please assess each trait by circling a number that indicates the degree of its importance in your purchasing decision. Here is an example question to help you correctly fill in Section I.

Example:

Question: How important is it to purchase a pick-up truck with **anti-lock brake system**?

Not Important 1 2 3 4 [✓ 5] 6 7 Very Important

Explanation: The individual considers that anti-lock brake system is a moderately important factor when considering the purchase of a pick-up truck.

---

1. How important is it for you to know the overall barley **quality levels** (which, for instance, indicate the levels of crude protein, amino acid, starch content, etc.)?

   Not Important 1 2 3 4 5 6 7 Very Important

2. How important is it to purchase feed barley with a **protein level** of 12.5% or higher?

   Not Important 1 2 3 4 5 6 7 Very Important

3. How important is it to purchase feed barley with high levels of the amino acid, **lysine** (expressed as 3.25% of crude protein or higher)?

   Not Important 1 2 3 4 5 6 7 Very Important

4. How important is it to purchase feed barley with high levels of the amino acid, **threonine** (expressed as 3.25% of crude protein or higher)?

   Not Important 1 2 3 4 5 6 7 Very Important

5. How important is it to purchase feed barley with **starch level** of 55% (on barley weight) or higher?

   Not Important 1 2 3 4 5 6 7 Very Important

6. How important is it to purchase feed barley with **moisture level** of 14.8% or lower?

Not Important	1	2	3	4	5	6	7	Very Important

7. How important is it to purchase feed barley with **foreign material** (e.g. wild oats or other grains) of 3.5% or lower?

Not Important	1	2	3	4	5	6	7	Very Important

8. How important is it to purchase feed barley with a **bushel weight** of 48 pounds per bushel or higher?

Not Important	1	2	3	4	5	6	7	Very Important

9. How important is it to purchase feed barley with **uniform kernels**?

Not Important	1	2	3	4	5	6	7	Very Important

10. How important is it that you **personally know** the seller of feed barley?

Not Important	1	2	3	4	5	6	7	Very Important

11. How important is it that the barley seller is willing to **negotiate on prices** of feed barley?

Not Important	1	2	3	4	5	6	7	Very Important

12. How important is it that the barley seller is willing to **guarantee barley quality** (e.g. free from pesticide residues, mould, etc.)?

Not Important	1	2	3	4	5	6	7	Very Important

13. How important is it that the barley seller is willing to enter a **long-term barley supply contract**?

Not Important	1	2	3	4	5	6	7	Very Important

End of Section I

Section II

In this section, there are 8 sets of choices concerning barley. For each scenario, there are three hypothetical choices (A, B and C). Each choice briefly describes a barley sample available for purchase. Assume that barley is dry, relatively free of dockage and has good color. Also, assume that the given choices are the only ones on your next purchase for feed barley. Would you choose A, B or would you choose neither? (Please choose only **ONE** choice for each question)

Glossary:

Weight – measured in number of pounds per bushel.

Price – expressed in Canadian dollars per tonne.

Detailed feed analysis – contains information about the levels of crude protein, starch and amino acid profile, which meets the minimum criteria of 12.5% crude protein, 55% starch content and amino acid such as lysine and threonine, expressed in percentage of crude protein. The description "yes" indicates document on the feed analysis is available.

Known Supplier – The description "yes" indicates a supplier, from whom you have purchased barley before.

Variety – indicates whether the barley is a feed variety or malt variety, and whether it is in 2-row or 6 row. The example for these varieties would be:

Harrington:	for 2-row malt variety
Bonanza:	for 6-row malt variety
Bridge:	for 2-row feed variety
AC Lacombe:	for 6-row feed variety

Trace back – The description "yes" indicates that the buyer is able to trace back the barley variety, fields grown as well as all agronomic practices (i.e. types of feed, herbicides, fungicides, insecticides, etc.).

Example:

Assume these are the descriptions of barley offered to you for purchase. Which one would you choose?

Product Specification	Choice A	Choice B	Choice C
Weight (lb/bushel)	53	49	Neither Choice A nor Choice B
Detailed feed analysis	Yes	No	
Known Supplier	Yes	No	
Variety	2-row feed	2-row malt	
Trace back	Yes	No	
Price (Cdn$/t)	80	90	
	⇩	⇩	⇩
I would choose	☑	☐	☐

Explanation for the above example: The individual prefers choice A to choice B or C. That is to say, the individual prefers to purchase a 2-row feed variety barley with detailed feed analysis, weight equal to 53 lb/bushel, priced at Cdn$80/t, and the barley comes from a supplier who has sold barley to the individual before. The barley can be traced back to the field grown, variety grown and other agronomic practices used.

Please answer the following:

SCENARIO 1 **Assume these are the descriptions of barley offered to you for purchase. Which one would you choose?**

Product Specification	**Choice A**	**Choice B**	**Choice C**
Weight (lb/bushel)	49	49	Neither Choice A nor Choice B
Detailed feed analysis	Yes	Yes	
Known Supplier	Yes	No	
Variety	6-row malt	6-row malt	
Trace back	No	No	
Price (Cdn$/t)	110	90	
	⇩	⇩	⇩
I would choose	☐	☐	☐

SCENARIO 2 **Assume these are the descriptions of barley offered to you for purchase. Which one would you choose?**

Product Specification	**Choice A**	**Choice B**	**Choice C**
Weight (lb/bushel)	45	49	Neither Choice A nor Choice B
Detailed feed analysis	No	No	
Known Supplier	Yes	Yes	
Variety	6-row feed	2-row feed	
Trace back	No	No	
Price (Cdn$/t)	80	100	
	⇩	⇩	⇩
I would choose	☐	☐	☐

SCENARIO 3 **Assume these are the descriptions of barley offered to you for purchase. Which one would you choose?**

Product Specification	**Choice A**	**Choice B**	**Choice C**
Weight (lb/bushel)	45	49	Neither Choice A nor Choice B
Detailed feed analysis	No	No	
Known Supplier	Yes	No	
Variety	6-row malt	2-row malt	
Trace back	Yes	No	
Price (Cdn$/t)	100	110	
	⇩	⇩	⇩
I would choose	☐	☐	☐

SCENARIO 4 **Assume these are the descriptions of barley offered to you for purchase. Which one would you choose?**

Product Specification	**Choice A**	**Choice B**	**Choice C**
Weight (lb/bushel)	49	45	Neither Choice A nor Choice B
Detailed feed analysis	No	No	
Known Supplier	Yes	Yes	
Variety	2-row malt	6-row malt	
Trace back	No	Yes	
Price (Cdn$/t)	90	100	
	⇩	⇩	⇩
I would choose	☐	☐	☐

SCENARIO 5 **Assume these are the descriptions of barley offered to you for purchase. Which one would you choose?**

Product Specification	**Choice A**	**Choice B**	**Choice C**
Weight (lb/bushel)	57	45	Neither Choice A nor Choice B
Detailed feed analysis	Yes	Yes	
Known Supplier	No	Yes	
Variety	6-row malt	2-row feed	
Trace back	No	No	
Price (Cdn$/t)	90	110	
	⇩	⇩	⇩
I would choose	☐	☐	☐

SCENARIO 6 **Assume these are the descriptions of barley offered to you for purchase. Which one would you choose?**

Product Specification	**Choice A**	**Choice B**	**Choice C**
Weight (lb/bushel)	53	57	Neither Choice A nor Choice B
Detailed feed analysis	No	Yes	
Known Supplier	Yes	Yes	
Variety	6-row feed	2-row feed	
Trace back	Yes	Yes	
Price (Cdn$/t)	110	90	
	⇩	⇩	⇩
I would choose	☐	☐	☐

SCENARIO 7 **Assume these are the descriptions of barley offered to you for purchase. Which one would you choose?**

Product Specification	**Choice A**	**Choice B**	**Choice C**
Weight (lb/bushel)	45	49	Neither Choice A nor Choice B
Detailed feed analysis	Yes	No	
Known Supplier	Yes	No	
Variety	2-row malt	2-row feed	
Trace back	Yes	No	
Price (Cdn$/t)	80	90	
	⇩	⇩	⇩
I would choose	☐	☐	☐

SCENARIO 8 **Assume these are the descriptions of barley offered to you for purchase. Which one would you choose?**

Product Specification	**Choice A**	**Choice B**	**Choice C**
Weight (lb/bushel)	45	57	Neither Choice A nor Choice B
Detailed feed analysis	Yes	No	
Known Supplier	No	No	
Variety	2-row malt	6-row feed	
Trace back	No	No	
Price (Cdn$/t)	90	90	
	⇩	⇩	⇩
I would choose	☐	☐	☐

End of section II

Section III

Please read each question and check "√ " or state the answer that corresponds closest to your opinion or your current situation.

1. What percentage of your feed is sold in the following markets?

Beef __________%
Dairy __________%
Pork __________%
Poultry __________%
Other __________%
100%

2. How many tonnes of feed crops do you purchase annually?

of barley ______________ tonnes
of wheat ______________ tonnes

3. When you purchase barley, do you prefer a particular variety of barley for feed? ____Yes
____No

If yes, please specify the variety ____________________________

4. Do you think that the current grading system of barley provided by Canadian Grain Commission (e.g. grading barley into No.1 C.W. and No.2 C.W. according to a specified minimum test weight and maximum limit of foreign material) is effective in providing the information for selecting the suitable barley for feed? ____Yes
____No

If no, please briefly discuss ____________________________
____
____
____

5. Do you test your barley for quality?____Yes
____No

6. Please list and rank the top four quality characteristics you look for in barley.

Rank 1. ____________________
2. ____________________
3. ____________________
4. ____________________

7. Do you purchase malting barley varieties for feed? ____Yes
____No

8. Do you purchase hulless barley varieties for feed? ____Yes
____No

9. Do you have long term purchase contracts for barley? ____Yes
____No

If yes, do you contract directly with the farmers? ____Yes
____No

10. Would you like to have long term purchase contracts for barley?
____Yes. If so, please briefly discuss ______________________________
____
____No. If so, please briefly discuss ______________________________
____

If your answer to question 10 is "yes", please answer question 11 or else please skip question 11.

11. Would you like to contract directly with the farmers?
____Yes. If so, please briefly discuss ______________________________
____
____No. If so, please briefly discuss ______________________________
____

Any additional comment, please write on the opposite side of this page.

~ The End ~

Thank you. Your contribution to this research effort is greatly appreciated.

APPENDIX II: Additional Comments from the Mail Surveys

The additional comments from the mail surveys are categorized under each of the following questions:

I. Why do the respondents consider Canadian Grain Commission (CGC) grading ineffective in providing information to select the suitable barley for feed?
II. Why do the respondents prefer long-term contracts?
III. Why do the respondents not prefer long-term contracts?
IV. Why do the respondents prefer to contract directly with farmers?
V. Why do the respondents not prefer to contract directly with farmers?

All the comments are direct quote.

Question One: Why do the respondents consider CGC grading ineffective in providing information to select the suitable barley for feed?

1. The criteria for selecting barley for grinding and rolling are different.
2. Grading should include kernel size.
3. Detailed analysis is the most important information.
4. Our standards are higher than the CGC grades.
5. No account of value is taken starch content.
6. Variability may be too great. Variety differences could be better documented for the feed industry so that the industry and producers could make more uniformed decisions.
7. Percentage plumpness is important as well as moisture and protein.
8. Export feed barley grading standards do not correlate with the domestic market requirements.
9. Need higher standard for foreign material because in rolled rations visually it is noticeable for producer particularly dairy producers.

Question Two: Why do the respondents prefer long-term contracts?

1. Guarantee consistent supply.
2. Prefer basis to cash price.
3. Guarantee supply for a portion of the market is important.

4. Long-term contracts allow for forward pricing as well as basis contracts to sell with locked in margins.
5. If supply from the producer is guaranteed, one can guarantee the supply to end-users.
6. Enable to manage price risk, delivery risk and quality.

Question Three: **Why do the respondents not prefer long-term contracts?**

1. Find better values on cash market.
2. At this time it is a buyers market. Price changes constantly.
3. Usage varies greatly depending on wheat prices. Prefer to buy spot to be able to accommodate customers (buying wheat 5 times more than barley, over 50% marketed to poultry industry).
4. Barley is always available for sale.
5. Do not purchase enough barley to make use of long term contracts.
6. May get caught on price versus local price due to price fluctuation.
7. Long term contract is not necessary because feed prices are changed monthly to reflect grain prices.

Question Four: **Why do the respondents prefer to contract directly with farmers?**

1. Farmers are a pure price without margins from brokers or line companies. In general farmers are a lower cost to our price than line companies.
2. Take out middleman.
3. Save handling & freight charges from line companies.
4. Farmers are the main suppliers.

Question Five: **Why do the respondents not prefer to contract directly with farmer?**

1. Most farmers at this point do not want to make long-term contracts or if they do they want to break them if it is beneficial to do so.
2. We purchase the majority of grain through our elevator, which deals directly with farmers.
3. Contract with producers is risky as time goes by many choose not to deliver their commitment especially if the price move higher. Also m any producers are very unaware of the quality of their production and quite often when they deliver their grain does not meet our minimum buying specifications.